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Manual of Criteria for the Qualification of Flight Simulation Training Devices

Volume 1 — Aeroplanes

Fourth Edition, 2015

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INTERNATIONAL CIVIL AVIATION ORGANIZATION

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AMENDMENTS

Amendments are announced in the supplements to the *Publications Catalogue;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS		
No.	Date	Entered by

CORRIGENDA		
No.	Date	Entered by
1	28/10/16	ICAO

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Foreword

This manual addresses the use of Flight Simulation Training Devices (FSTDs) representing aeroplanes (Volume I) and helicopters (Volume II). The methods, procedures and testing standards contained in this manual are the result of the experience and expertise provided by Civil Aviation Authorities (CAA) and aeroplane and FSTD operators and manufacturers.

First Edition

From 1989 to 1992 a specially convened international working group held several meetings with the stated purpose of establishing common test criteria that would be recognized internationally. The criteria that resulted from the activities of this working group were presented to a Conference held in London, United Kingdom, in January 1992. These criteria were contained in the appendices to the first edition of this manual. Appendix A described the minimum requirements for qualifying aeroplane flight simulators of two levels (Levels I and II). The validation and functional tests associated with the particular level of flight simulator were contained in Appendices B and C.

Second Edition

During 2001, a working group under the joint chairmanship of the US Federal Aviation Administration (FAA) and the European Joint Aviation Authorities (JAA) held two meetings to review and modernize the standards contained within this manual. The second edition of this manual updated the minimum standards for aeroplane flight simulator qualification. This reflected the changes in both simulation technology and the understanding of the process of flight simulator qualification in the previous ten years. As a result of technology changes and operational tasks, this manual only defined the highest level of flight simulator. Changes were made to the standards and testing requirements in each appendix. These changes were introduced with great care being exercised to avoid increasing the burden of testing unnecessarily. As before, Appendix A described the minimum requirements for qualifying flight simulators. The validation and functions tests were contained in Appendices B and C. Finally, Attachments A through H were added as information and explanatory material to provide advice and guidance for all interested parties.

Third Edition

The technical standards defined within the second edition now formed the basis for the highest level of aeroplane flight simulator in both FAA 14 CFR Part 60 — *Flight Simulation Training Device Initial and Continuing Qualification and Use* and JAR–FSTD A — *Aeroplane Flight Simulation Training Devices*. The FAA, the JAA and other CAA had developed their own standards for the complete range of FSTDs for both aeroplanes and helicopters. Most recently, ICAO's Flight Crew Licensing and Training Panel additionally identified the need for four levels of aeroplane FSTDs to support the multi-crew pilot licence (MPL).

At the Flight Simulation Conference of the Royal Aeronautical Society (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 this manual 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 this manual and to expand these accordingly. The IWG also decided that a fundamental review was necessary to establish the simulation 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.

Fourth Edition

In 2009, the International Committee for Aviation Training in Extended Envelopes (ICATEE) was established by the RAeS to develop training mitigations for accidents resulting from loss of control in flight. In 2012, ICAO sponsored meetings which brought together experts addressing this issue, including regulators and the respective FAA Aviation Rulemaking Committee. The Loss of Control Avoidance and Recovery Training Initiative evolved from these meetings and worked with industry, the FAA Aviation Rulemaking Committee and ICATEE to produce guidance material to support new licensing and training requirements. Such guidance material includes the qualification of FSTDs for upset prevention and recovery training (UPRT) introduced in this edition.

In addition, various specialist working groups developed new or updated guidance material for this edition as follows:

— updated simulated air traffic control environment related material which aligns with ARINC provisions;

— updated objective motion cueing tests to reduce motion system tests' reliance on subjective evaluations and improve harmonization of motion system fidelity;

— updates that reflect the industry's progress in technology; and

— editorial and technical changes to improve the document.

The guidance material for inclusion in the fourth edition was produced by the Training Device Work Stream of the International Pilot Training Consortium[1] that currently manages Doc 9625 updates, in coordination with ICAO.

Comments on this manual would be appreciated. They will be taken into account in the preparation of subsequent editions. Comments concerning the manual should be addressed to:

The Secretary General
International Civil Aviation Organization
999 Robert-Bourassa Boulevard
Montréal, Quebec
Canada H3C 5H7

[1] See www.icao.int/NACC/Documents (eDOCS, FS, FS-Flyer_US-Letter_ANB-IPTC_2013-08-19.pdf)

Introductory Material

The manual comprises two volumes, each containing three parts as follows:

Volume I — Manual of Criteria for the Qualification of FSTDs — Aeroplanes

Part I	—	Training Task Derived Flight Simulation Requirements
Part II	—	Flight Simulation Training Device Criteria
Part III	—	Flight Simulation Feature and Fidelity Level Criteria

Volume II — Manual of Criteria for the Qualification of FSTDs — Helicopters

Part I	—	Training Task Derived Flight Simulation Requirements
Part II	—	Flight Simulation Training Device Criteria
Part III	—	Flight Simulation Feature and Fidelity Level Criteria

Sections common to more than one part are only presented in Part II.

The process used to define flight simulation requirements was to conduct an analysis identifying tasks to be accomplished for the training and testing or checking types applicable to the various licences. Figure 1 summarizes this process.

The process outcome defines levels of fidelity of simulation features required to support the training tasks associated with existing pilot licensing, qualification, rating or training types, leading to the identification of seven standard examples of FSTDs. These FSTD examples are summarized in Part I, Appendix B, and are referred to as "Device Types" in Part II.

Individual flight simulation feature and fidelity level criteria are provided in Part III and will provide the industry with criteria for the purposes of:

- international standardization of FSTD qualification;
- tailoring of existing FSTDs to meet existing or future training needs; and
- design of new FSTDs to meet existing or future training needs.

In summary:

Pilot Licensing, Qualification, Rating or Training Type
The fifteen training types considered are from various CAA definitions. Reference Volume I, Part I, Chapter 4.

Training Tasks
The training tasks (approximately 200) were derived from the *Procedures for Air Navigation Services — Training* (PANS–TRG, Doc 9868) as well as material from FAA 14 CFR Part 60 and other CAA documentation. Reference Volume I, Part I, Chapter 5.

Simulation Features
Twelve simulation features were defined using the FSTD standards tables contained in JAR FSTD A and FAA 14 CFR Part 60 to act as building blocks to describe any level of FSTD. Reference Volume I, Part I, Chapter 6.

Other relevant FSTD features related to instructor operating station, self-diagnostic testing, updates to hardware and software, etc. are covered under a separate simulation feature "Miscellaneous" and apply to all FSTDs.

Fidelity levels
Four fidelity levels of simulation feature were identified:

- none or not required (N);
- generic (G);
- representative (R); and
- specific (S).

These definitions are explained in more detail in Volume I, Part I, Chapter 3 through Chapter 6.

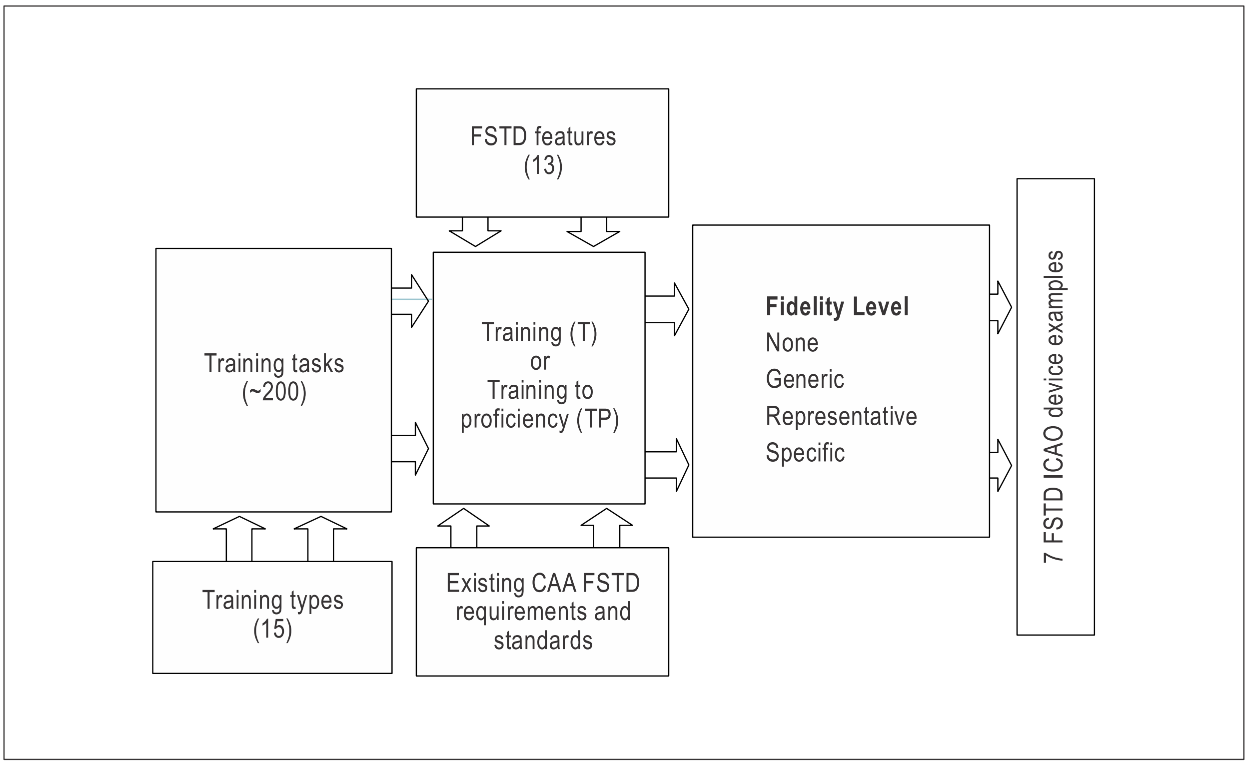

Figure 1. Training analysis process

MANUAL OF CRITERIA FOR THE QUALIFICATION OF FLIGHT SIMULATION TRAINING DEVICES

Volume I

Aeroplanes

Part I

Training Task Derived Flight Simulation Requirements

Chapter 1

GLOSSARY OF TERMS, ABBREVIATIONS AND UNITS

The terms, abbreviations and units used in this document are described in Part II, Chapter 1.

Chapter 2

VOLUME I CONTENT

2.1 GUIDANCE PROVIDED IN VOLUME I

Volume I provides guidance for the following:

- the process and methodology for FSTD qualification; and
- the training tasks that can be partly trained or trained to proficiency in a qualified FSTD.

2.2 PARTS TO VOLUME I

2.2.1 Part I — Training task derived flight simulation requirements

Part I contains an analysis of training tasks and related simulation feature and fidelity level requirements, including:

- a description of the tasks considered throughout a broad range of pilot licensing, qualification, rating and training requirements (see Chapter 4);
- a summary of seven standard FSTD examples (see Appendix B); and
- a reference to the training task matrix which compares each task, differentiated on the basis of licence or qualification requirements, against the suite of simulation features. Each simulation feature is defined at a "Specific", "Representative" or "Generic" level of fidelity, or "None" (i.e. the feature is not required).

2.2.2 Part II — Flight simulation training device criteria

Part II describes the FSTD general requirements, objective tests, and functions and subjective tests to qualify the seven defined examples of FSTD referenced in the summary matrix in Part I, Appendix B.

2.2.3 Part III — Flight simulation feature and fidelity level criteria

Part III describes the general requirements, objective tests, and functions and subjective tests for the individual flight simulation features, and the fidelity levels to enable qualification of any FSTD.

Chapter 3

FSTD QUALIFICATION CRITERIA DETERMINATION PROCESS

3.1 PROCESS

Figure 3-1 provides a step-by-step process map to determine the fidelity levels and qualification criteria for the simulation features according to training task considerations. This enables the construction of a specific FSTD Qualification Test Guide (QTG). The process is outlined below:

Step 1 — Licence or Training Type. The FSTD operator identifies the intended use of the FSTD with reference to the pilot licence and qualification types listed in Chapter 4 and level of training or checking as defined in Chapter 8.

Step 2 — Determine the list of training tasks for licence or training type.

Decision. Confirm that the training tasks listed in Part I, Appendix A for the licence or training type chosen fulfil the FSTD operator's and CAA's requirements.

If **yes**, proceed to step 3 a). If **no**, proceed to step 3 b).

Step 3 a) — Determine the appropriate FSTD type example by referring to Part I, Appendix B. Disregard step 3 b).

Step 3 b) — Determine the changes to the FSTD features/fidelity levels or training tasks by referring to Part I, Appendix C. Proceed to step 4 b).

Decision. Does the FSTD under consideration meet the selected FSTD type example (I through VII) in Part I, Appendix B?

If **yes**, proceed to step 4 a). If **no**, proceed to step 4 b).

Step 4 a) — Determine the statements of compliance (SOCs) and testing requirements for the FSTD qualification by referring to Part II, Appendices A, B and C. Proceed to Step 5.

Step 4 b) — Determine the statements of compliance (SOCs) and testing requirements for the FSTD qualification by referring to Part III, Appendices A, B and C.

Step 5 — Construct the Qualification Test Guide (QTG).

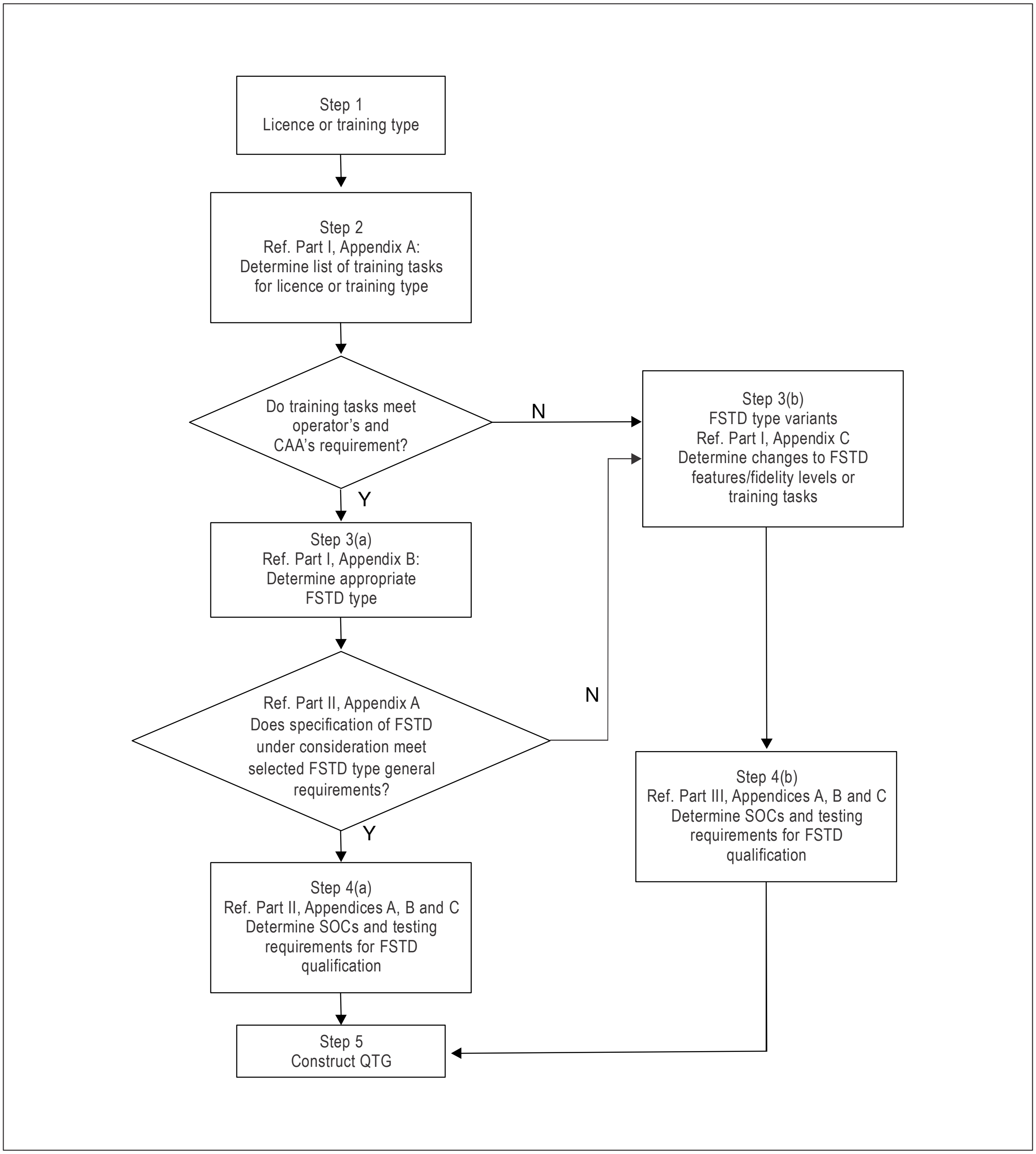

Figure 3-1. QTG Specification process map

3.2 ADDITIONAL NOTES

3.2.1 As a future-proofing measure, a CAA may, within an accepted training programme offered at an approved training organization (ATO), authorize the use of an FSTD qualified under an alternative means of compliance from the device requirements established by Part I of this document.

3.2.2 A deviation from the criteria in Part II may be considered if the ATO demonstrates, to the satisfaction of the CAA, that the use of the FSTD achieves a training standard at least equivalent to that provided on a device traditionally used in a similar programme.

3.2.3 When it becomes apparent that a device type example from Part I, Appendix B, is not selected, the CAA should be consulted very early in the device definition process, and the overall process defined above should be followed.

3.2.4 If any of the device features differ from those of the seven type examples in Part I, Appendix B, appropriate objective validation, functions and subjective tests will need to be defined using the information provided in Part III. These differences should be documented in the statement of qualification that also includes the authorized training or checking tasks sought and the contents of the authorized training programme. In this case, the device should be referred to as an FSTD type I-VIIΔ (Delta), e.g. type IVΔ.

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Chapter 4

LICENCE OR TYPE OF TRAINING

4.1 The fifteen pilot licensing, qualification, rating or training types identified that might utilize some level of FSTD were identified as follows from a review of existing regulatory material:

4.1.1 From ICAO Annex 1 — *Personnel Licensing* and the *Procedures for Air Navigation Services — Training* (PANS-TRG, Doc 9868):

a) MPL1 — Multi-crew Pilot Licence — Phase 1, Core flying skills;

b) MPL2 — Multi-crew Pilot Licence — Phase 2, Basic;

c) MPL3 — Multi-crew Pilot Licence — Phase 3, Intermediate; and

d) MPL4 — Multi-crew Pilot Licence — Phase 4, Advanced.

4.1.2 Traditional licence and rating types or training types from FAA and JAA regulations:

a) IR — Initial Instrument Rating;

b) PPL — Private Pilot Licence;

c) CPL — Commercial Pilot Licence;

d) TR — Type Rating Training and Checking;

e) CR — Class Rating;

f) RL — Recurrent Licence (Proficiency) Training and Checking;

g) RO — Recurrent Operator (Proficiency) Training and Checking;

h) Re — Recency (Take-off and Landing);

i) CQ — Continuing Qualification;

j) IO — Initial Operator Training and Checking; and

k) ATPL — Airline Transport Pilot Licence or Certificate.

Chapter 5

TRAINING TASKS

5.1 The following definitions extracted from the *Procedures for Air Navigation Services — Training* (PANS-TRG, Doc 9868) were used in the construction of the training matrix:

5.1.1 *Competency*. A combination of skills, knowledge and attitudes required to perform a task to the prescribed standard.

5.1.2 *Competency-based training and assessment.* Training and assessment that are characterized by a performance orientation, emphasis on standards of performance and their measurement, and the development of training to the specified performance standards.

5.1.3 *Competency element.* An action that constitutes a task that has a triggering event and a terminating event that clearly defines its limits, and an observable outcome.

5.1.4 *Competency unit*. A discrete function consisting of a number of competency elements. The nine competency units that are required to be demonstrated are as follows:

a) apply threat and error management principles;

b) perform aeroplane ground and pre-flight operations;

c) perform take-off;

d) perform climb;

e) perform cruise;

f) perform descent;

g) perform approach;

h) perform landing; and

i) perform after-landing and post-flight operations.

5.2 The training tasks considered include all those that are required to be trained or to be trained to proficiency for each of the training types or licences listed in Chapter 4. They are shown in detail in Appendix A and were assembled from the following documents:

a) Annex 1 — Personnel Licensing and Annex 6 — Operation of Aircraft, Part I — International Commercial Air Transport — Aeroplanes for specific upset prevention and recovery training tasks;

b) PANS-TRG; and

c) FAA 14 CFR Part 60.

5.3 The following are examples from PANS-TRG of the training tasks down to the competency element level:

"**. . .** 3. Perform Take-off

. . .

3.1 Perform pre-take-off and pre-departure preparation
3.2 Perform take-off roll
3.3 Perform transition to instrument flight rules
3.4 Perform initial climb to flap retraction altitude
3.5 Perform rejected take-off
3.6 Perform navigation
3.7 Manage abnormal and emergency situations

4. Perform Climb

. . .

4.1 Perform standard instrument departure/en-route navigation
4.2 Complete climb procedures and checklists
4.3 Modify climb speeds, rate of climb and cruise altitude
4.4 Perform systems operations and procedures
4.5 Manage abnormal and emergency situations
4.6 Communicate with cabin crew, passengers and company **. . .**"

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Chapter 6

FSTD SIMULATION FEATURES

6.1 To assist in the definition of the FSTDs and to provide focus for the training analysis, it was decided to break down the FSTD into some key components that would lead towards the construction of the FSTD Specification. Consequently, twelve FSTD features were defined from a training perspective that, used together and with an additional "Miscellaneous" feature, create an FSTD as follows:

6.1.1 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.

6.1.2 Flight model (aerodynamics and engine). Defines the mathematical models and associated data to be used to describe the aerodynamic and propulsion characteristics required to be modelled in the FSTD.

6.1.3 Ground handling. Defines the mathematical models and associated data to be used to describe the ground handling characteristics and runway conditions required to be modelled in the FSTD.

6.1.4 Aeroplane systems. Defines the types of aircraft systems simulation required to be modelled in the FSTD. The ATA chapter definitions describe these in more detail (e.g. hydraulic power, fuel, electrical power). Systems simulation will allow normal, abnormal and emergency procedures to be accomplished.

6.1.5 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 required to be modelled in the FSTD.

6.1.6 Sound cues. Defines the type of sound cue required to be modelled. 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.

6.1.7 Visual 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. HUD and EFVS options are also addressed.

6.1.8 Motion cues. Defines the type of motion cueing required to be modelled that may be generated by the aircraft dynamics and from other such effects as airframe buffet, control surface buffet, weather and ground operations.

6.1.9 Environment — ATC. Defines the level of complexity of the simulated Air Traffic Control environment and how it interacts with the flight crew under training. The focus of this feature is on the terminal manoeuvring or control area phase of flight.

6.1.10 Environment — Navigation. Defines the level of complexity of the simulated navigation aids, systems and networks with which the flight crew members are required to operate, such as GPS, VOR, DME, ILS or NDB.

6.1.11 Environment — Atmosphere and weather. Defines the level of complexity of the simulated weather conditions, from ambient temperature and pressure to full thunderstorm modelling, etc.

6.1.12 Environment — aerodromes and terrain. Defines the complexity and level of detail of the simulated aerodrome and terrain modelling required. This includes such items as generic versus customized aerodromes, visual scene requirements, terrain elevation and EGPWS databases.

6.1.13 Miscellaneous. Defines criteria for the following FSTD miscellaneous feature technical requirements:

- instructor operating station;
- self-diagnostic testing;
- computer capacity;
- automatic testing facilities;
- updates to hardware and software;
- daily pre-flight documentation; and
- system integration (transport delay).

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Chapter 7

SIMULATION FEATURE FIDELITY LEVELS

7.1 Four fidelity levels, i.e. None, Generic, Representative and Specific, were used in the analysis in deciding for each training task the minimum level of fidelity required for each simulation feature, except for the "Miscellaneous" feature. These can be grouped into three categories as follows:

7.1.1 *Aircraft simulation* comprising the following simulation features:

a) flight deck layout and structure;

b) flight model (aerodynamics and engine);

c) ground handling;

d) aeroplane systems; and

e) flight controls and forces.

7.1.2 *Cueing simulation* comprising the following simulation features:

a) sound cues;

b) visual cues; and

c) motion cues.

7.1.3 *Environment simulation* comprising the following simulation features:

a) environment — ATC;

b) environment — navigation;

c) environment — atmosphere and weather; and

d) environment — aerodromes and terrain.

7.2 Fidelity levels for each feature category are described in Table 7-1.

Table 7-1. Fidelity levels for each feature category

Level	Aircraft simulation	Cueing simulation	Environment simulation
None	Not required.	Not required.	Not required.
Generic	Not specific to aeroplane model, type or variant.	Generic to an aeroplane of its class. Simple modelling of key basic cueing features. For *visual cueing* only: 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.	For *sound and motion cueing* only: replicates the specific aeroplane to the maximum extent possible. However, physical limitations currently only provide representative, not specific, cues. For *visual cueing* only: representative of the real-world visual environment and perspective.	Representative of the real-world environment.
Specific	Replicates the specific aeroplane.	Applicable to *visual cueing* only: 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.

Chapter 8

TRAINING AND TRAINING-TO-PROFICIENCY

8.1 The "building block approach" to flight training recognizes the capability of accomplishing the procedural components of piloting tasks, including pilot manual handling tasks, in FSTDs without certain features (such as motion cues) or reduced feature fidelity levels (such as for visual cues). Utilizing this approach, the training master matrix described in Appendix C assigns fidelity feature levels for each listed task where, as a minimum, training (T) is supported. Training is not completed until all tasks listed as training-to-proficiency (TP) are completed utilizing the relevant TP device type.

8.2 Definitions of the terms "train" (T) and "train-to-proficiency" (TP) are in Part II, Chapter 1.

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Chapter 9

REFERENCES AND RELATED READING MATERIAL

9.1 Applicants seeking FSTD evaluation, qualification and approval should consult references contained in related documents published by the International Civil Aviation Organization (ICAO), the International Air Transport Association (IATA) and the Royal Aeronautical Society (RAeS) referring to and/or dealing with the use of FSTDs and technical and operational requirements relevant to FSTD data and design. Applicable rules and regulations pertaining to the use of FSTDs in the State for which the FSTD qualification and approval is requested should also be consulted.

9.2 The related national and international documents which form the basis of the criteria set out in this document are listed in Part II, Chapter 2.

Appendix A

TRAINING TASK vs TRAINING/LICENCE TYPE MATRIX

1. INTRODUCTION

1.1 The matrix contained in this appendix is derived from the master matrix and corresponds to Chapter 3, Figure 3-1, FSTD QTG Specification Process Map, Step 2. It allocates the tasks considered appropriate for each of the licensing, qualification, rating or training types defined in Chapter 4 for which use of an appropriately qualified FSTD is suitable.

1.2 Explanatory notes to aid understanding the matrix are as follows:

- TP is conducted only in an aeroplane for PPL, CPL, CR, IR and MPL1;

- Recency (Re) is only considered as a T exercise (and not TP);

- for MPL phases 1 to 4, only the ICAO-designated PANS–TRG training tasks were considered with the addition of upset prevention, recognition and recovery (associated with Training Tasks in the set of ICAO and MISC tasks); and

- for all other licensing, qualification, rating or training types, the FAA *Airline Transport Pilot and Type Rating Practical Test Standards* (see Part II, Chapter 2, 2.3.2) designated tasks have been considered in addition to the ICAO MPL tasks.

2. TRAINING TASK VS TRAINING/LICENCE TYPE MATRIX

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
ICAO	**2. Perform Aircraft Ground and Pre-Flight Operations**															
ICAO	2.1 Perform dispatch duties	*N/A*	T,TP	T,TP	T,TP	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	2.2 Provide flight crew and cabin crew briefings	*N/A*	T,TP	T,TP	T,TP	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	2.3 Perform pre-flight checks and cockpit preparation	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	2.4 Perform engine start	T	T,TP	T,TP	T,TP	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	2.5 Perform taxi out	T	T,TP	T,TP	T,TP	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	2.6 Manage abnormal and emergency situations	T	T,TP	T,TP	T,TP	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	2.7 Communicate with cabin crew, passengers and company	*N/A*	T,TP	T,TP	T,TP	*N/A*	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	**3. Perform Take-off**															
ICAO	3.1 Perform pre-take-off and pre-departure preparation	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	3.2 Perform take-off roll	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	T	TP	T,TP
ICAO	3.3 Perform transition to instrument flight rules	T	T,TP	T,TP	T,TP	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	3.4 Perform initial climb to flap retraction altitude	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	T	TP	T,TP
ICAO	3.5 Perform rejected take-off	T	T,TP	T,TP	T,TP	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	3.6 Perform navigation	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	3.7 Manage abnormal and emergency situations	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	**4. Perform Climb**															
ICAO	4.1 Perform standard instrument departure/en-route navigation	*N/A*	T,TP	T,TP	T,TP	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	4.2 Complete climb procedures and checklists	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
ICAO	4.3 Modify climb speeds, rate of climb and cruise altitude	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	4.4 Perform systems operations and procedures	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	4.5 Manage abnormal and emergency situations	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	4.6 Communicate with cabin crew, passengers and company	*N/A*	T,TP	T,TP	T,TP	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	**5. Perform Cruise**															
ICAO	5.1 Monitor navigation accuracy	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	5.2 Monitor flight progress	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	5.3 Perform descent and approach planning	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	5.4 Perform systems operations and procedures	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	5.5 Manage abnormal and emergency situations	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	5.6 Communicate with cabin crew, passengers and company	*N/A*	T,TP	T,TP	T,TP	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	**6. Perform Descent**															
ICAO	6.1 Initiate and manage descent	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	6.2 Monitor and perform en-route and descent navigation	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	6.3 Replanning and update of approach briefing	*N/A*	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	6.4 Perform holding	*N/A*	T,TP	T,TP	T,TP	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	6.5 Perform systems operations and procedures	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	6.6 Manage abnormal and emergency situations	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
ICAO	6.7 Communicate with cabin crew, passengers and company	*N/A*	T,TP	T,TP	T,TP	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	**7. Perform Approach**															
ICAO	7.1 Perform approach in general	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	T	TP	T,TP
ICAO	7.2 Perform precision approach	*N/A*	T,TP	T,TP	T,TP	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	7.3 Perform non-precision approach	*N/A*	T,TP	T,TP	T,TP	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	7.4 Perform approach with visual reference to ground	*N/A*	T,TP	T,TP	T,TP	T	*N/A*	*N/A*	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	7.5 Monitor the flight progress	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	7.6 Perform systems operations and procedures	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	7.7 Manage abnormal and emergency situations	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	7.8 Perform go-around/missed approach	T	T,TP	T,TP	T,TP	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	7.9 Communicate with cabin crew, passengers and company	*N/A*	T,TP	T,TP	T,TP	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	**8. Perform Landing**															
ICAO	8.1 Land the aircraft	T	T,TP	T,TP	T,TP	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	T	TP	T,TP
ICAO	8.2 Perform systems operations and procedures	T	T,TP	T,TP	T,TP	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	8.3 Manage abnormal and emergency situations	T	T,TP	T,TP	T,TP	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	**9. Perform After-Landing and Post Flight Operations**															
ICAO	9.1 Perform taxi-in and parking	T	T,TP	T,TP	T,TP	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	9.2 Perform aircraft post-flight operations	*N/A*	T,TP	T,TP	T,TP	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	9.3 Perform systems operations and procedures	T	T,TP	T,TP	T,TP	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
ICAO	9.4 Manage abnormal and emergency situations	T	T,TP	T,TP	T,TP	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	9.5 Communicate with cabin crew, passengers and company	*N/A*	T,TP	T,TP	T,TP	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
ICAO	Upset prevention, recognition and recovery	*N/A*	T,TP	*N/A*	T,TP	*T*	*N/A*	T	T,TP	*N/A*	*N/A*	*N/A*	T,TP	*N/A*	TP	T,TP
FAA	**1.0 All Operations**															
FAA	1.1 Normal, abnormal, and emergency procedures	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	1.2 Operation of systems and controls at FE panel	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	1.3 Human factors and CRM	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	1.4 Aircraft handling standards	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	1.5 ATC communications and procedures	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	1.6 Seat dependent training	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	**2.0 Pre-flight Procedures**															
FAA	2.1 Planning	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	2.2 Flight deck inspection	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	2.3 Cabin inspection	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	2.4 Exterior inspection	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	2.5 Navigation system setup	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	**3.0 Ground Operations**															
FAA	3.1.1 Engine start — Normal	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	3.1.2 Engine start — Non-normal	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	3.2 Pushback or powerback	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	3.3 Taxi	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	3.4 Pre-take-off procedures	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
FAA	3.5 After Landing	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	3.6 Parking and securing	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	**4.0 Take-off**															
FAA	4.1 Normal and crosswind — all engines operating	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	4.2 Instrument with lowest authorized RVR	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	4.3.1 With engine failure — between V_1 and V_r	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	4.4 Rejected with lowest authorized RVR	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	4.5 Short-field take-off and maximum performance climb	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	**5.0 Performance Manoeuvres**															
FAA	5.1 Steep turns	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	5.2 Steep spiral	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	5.3 Chandelles	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	5.4 Lazy eights	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	**6.0 Ground Reference Manoeuvres**															
FAA	6.1 Eights on Pylons	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	6.2 Turns about a point	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	6.3 "S-Turns" across a road or section line	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	**7.0 Departure, Climb, Cruise, Descent, and Arrival.**															
FAA	7.1 Instrument departure	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	7.2 Climb	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
FAA	7.3 One-engine inoperative, en-route	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	7.4 En-route navigation	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	7.5 Descent	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	7.6 Instrument arrival	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	7.7 Holding	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	7.8 Intercepting and tracking nav. system and DME arcs	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	7.9 Aircraft control by reference to instruments	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	7.10 Approach transition	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	**8.0 Aircraft Handling**															
FAA	8.1.1.1 Stalls — Recovery from: power-off stalls	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	8.1.2.1 Recognition/recovery from, approach to stall: clean configuration	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	8.1.2.2 Recognition/recovery from, approach to stall: take-off and manoeuvring configuration	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	8.1.2.3 Recognition/recovery from, approach to stall: landing configuration	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	8.1.2.4 Recognition/recovery from, approach to stall: landing configuration with A/P engaged	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	8.2.1 Asymmetric thrust: engine shutdown	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
FAA	8.2.2 Asymmetric thrust: Manoeuvring with one engine inoperative	N/A	N/A	N/A	N/A	N/A	N/A	T	T,TP	T,TP	T	T,TP	T,TP	N/A	TP	T,TP
FAA	8.2.3 Asymmetric thrust: engine restart	N/A	N/A	N/A	N/A	N/A	N/A	T	T,TP	T,TP	T	T,TP	T,TP	N/A	TP	T,TP
FAA	8.3 Runaway trim and stabilizer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.4 Jammed trim and stabilizer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.5 Upset recognition and recovery	N/A	N/A	N/A	N/A	T	N/A	T	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.6 Slow flight	N/A	N/A	N/A	N/A	N/A	T	T	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.7 Turns with and without spoilers	N/A	N/A	N/A	N/A	N/A	N/A	N/A	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.8 Stability augmentation inoperative	N/A	N/A	N/A	N/A	N/A	N/A	N/A	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.9 Mach tuck and Mach buffet	N/A	N/A	N/A	N/A	N/A	N/A	N/A	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.10 High sink rate	N/A	N/A	N/A	N/A	N/A	N/A	N/A	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.11 Flight envelope protection demonstration	N/A	N/A	N/A	N/A	N/A	N/A	N/A	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.12.1 Wind shear: during take-off	N/A	N/A	N/A	N/A	N/A	N/A	N/A	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.12.2 Wind shear: during departure	N/A	N/A	N/A	N/A	N/A	N/A	N/A	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.12.3 Wind shear: during approach	N/A	N/A	N/A	N/A	N/A	N/A	N/A	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.13 Traffic avoidance (TCAS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.14 Terrain avoidance (EGPWS or TAWS).	N/A	N/A	N/A	N/A	N/A	N/A	N/A	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP
FAA	8.15 Spin awareness	N/A	N/A	N/A	N/A	N/A	T	T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FAA	8.16 High altitude operations	N/A	N/A	N/A	N/A	N/A	N/A	T	T,TP	T,TP	N/A	T,TP	T,TP	N/A	TP	T,TP

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
FAA	**9.0 Instrument Approaches**															
FAA	9.1 All engines operating — autopilot coupled	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	9.2 All engines operating — manually flown	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	9.3 One engine inoperative — manually flown	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	9.4.1 Approach type: category II and III	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	9.4.2 Approach type: precision groups	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	9.4.3 Approach type: non-precision groups	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	9.4.4 Approach type: ground based radar approach	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	**10.0 Visual Approach**															
FAA	10.1 All engines operating (normal)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	10.2 One engine inoperative	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	10.3 Two engines inoperative (3 or 4 engine a/c)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	**11.0 Missed Approach**															
FAA	11.1 All engines operating	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	11.2 One engine inoperative	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	11.3 From a circling approach when authorized	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	11.4 Descending break-out from PRM approach	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
FAA	**12.0 Landing**															
FAA	12.1 All engines operating	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.2 Crosswind	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.3.1 With engine failure: one engine inoperative	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.3.2 With engine failure: two engines inoperative (3 or 4 engine aircraft)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.4.1 Landing transition: from a precision approach	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.4.2 Landing transition: from a non-precision approach	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.4.3 Landing transition: from a visual approach	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.4.4 Landing transition: from a circling approach	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.5 Rejected landing	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.6 Zero or partial flaps	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	T	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.7 Auto-land	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.8 Enhanced flight vision system (EFVS)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.9 Head-up display (HUD)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	12.10 Landing from a short-field approach	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
FAA	12.11 Accuracy landing	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
FAA	**13.0 Abnormal Procedures**															
FAA	13.1 Un-annunciated	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.0 Systems (ATA Chapters)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.1 Air conditioning (21)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.2 Auxiliary power unit (49)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.3 Autopilot (22)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.4 Brakes (32)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.5 Communications (23)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.6 Doors (52)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.7 Electrical power (24)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.8 Emergency equipment (25)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.9 Engine (72)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.10 Fire protection (26)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.11 Flaps (27)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.12 Flight controls (27)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.13 Fuel (28)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.14 EGPWS/TAWS (34)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.15 HUD (34)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
FAA	13.2.16 Hydraulic power (29)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.17 Ice/rain protection (30)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.18 Instruments (31)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.19 Landing gear (32)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.20 Navigation (34)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.21 Oxygen (35)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.22 Pneumatics (36)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.23 Propellers (61)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.24 Stall warning (27)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.25 Thrust reversers (78)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	13.2.26 Warning systems (various)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	**14.0 Emergency Procedures**															
FAA	14.1 Fire/smoke in aircraft	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	14.2 Un-annunciated fire in flight	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	14.4 Emergency descent (maximum rate)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	14.5 Rapid decompression	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	14.6 Emergency evacuation	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	14.7 Engine fire, severe damage, or separation	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	14.8 Landing with degraded flight controls	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
FAA	14.9 Pilot incapacitation	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	14.10 All other emergencies as in the FCOM	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP
FAA	**15.0 Line Oriented Operations Environments**															
FAA	15.1 Anti-icing and de-icing before take-off	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	T	T	*N/A*	*N/A*	*N/A*
FAA	15.2 Structural icing, airborne	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	T	T	*N/A*	*N/A*	T
FAA	15.3 Thunderstorm avoidance	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	T	T	*N/A*	*N/A*	T
FAA	15.4 Contaminated runway operations	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	T	T	*N/A*	*N/A*	T
FAA	15.5 High density altitude runway operations	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	T	T	*N/A*	*N/A*	T
FAA	15.6 CFIT and terrain avoidance	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	T	T	*N/A*	*N/A*	T
FAA	15.7 ETOPS procedures	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	T	T	*N/A*	*N/A*	T
FAA	15.8 Altimeter settings (U.S. and international operations)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	T	T	*N/A*	*N/A*	T
FAA	15.9 Air hazard avoidance	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	T	T	*N/A*	*N/A*	T
FAA	15.10 Terrain avoidance (EGPWS or TAWS)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	T	T	*N/A*	*N/A*	T
MISC	Forced landing	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
MISC	Fuel dumping	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	T	T	*N/A*	*N/A*	T
MISC	Take-off at maximum take-off mass	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T	T	*N/A*	T	T	*N/A*	*N/A*	T
MISC	Low energy awareness	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	*N/A*	T	T	*N/A*	*N/A*	T
MISC	Level flight, cruise configuration, control of heading, altitude and airspeed	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T	T	*N/A*	T	T	*N/A*	*N/A*	T
MISC	Climbing and descending turns with 10°–30° bank	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	T	T	T	*N/A*	T	T	*N/A*	*N/A*	T
MISC	Recoveries from unusual attitudes	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
MISC	Limited panel instruments	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	T	T	T	*N/A*	T	T	*N/A*	*N/A*	T

Ref	Unit/Element	MPL1	MPL2	MPL3	MPL4	IR	PPL	CPL	TR	ATPL	CR	RL	RO	RE	CQ	IO
MISC	Control of the aeroplane by reference solely to instruments, including level flight at various speeds and trim settings	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
MISC	Climbing and descending turns with sustained Rate 1 turn	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	*N/A*	T,TP	*N/A*	T,TP	T	*N/A*	T	T,TP	*N/A*	*N/A*	*N/A*	T,TP	*N/A*	*N/A*	T,TP
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	*N/A*	T,TP	*N/A*	T,TP	T	*N/A*	T	T,TP	*N/A*	*N/A*	*N/A*	T,TP	*N/A*	TP	T,TP
MISC	Limited panel, stabilised climb or descent at Rate 1 turn onto given headings, recovery from unusual attitudes	*N/A*	T,TP	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
MISC	Approach transition IAF-FAF	*N/A*	*N/A*	*N/A*	*N/A*	T	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
MISC	Manual precision approach without flight director	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	T,TP	T,TP	*N/A*	T,TP	T,TP	*N/A*	TP	T,TP

Appendix B

FSTD SUMMARY MATRIX

1. SUMMARY MATRIX

For FSTD operators that use the seven FSTD standard examples, the summary matrix of Table B-1 applies.

Note.— The content of the summary matrix is considered to have precedence over the contents of the master matrix.

Table B-1. FSTD Summary Matrix

Licence or type of training	Device Type	T/TP	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
MPL4 — Advanced	VII	T+TP	S	S	S	S	S	R	S	R	S	S	R	R
TR / ATPL	VII	TP	S	S	S	S	S	R	S	R	S	S	R	R
Re	VII	T	S	S	S	S	S	R	S	R	N	S	R	R
RL / RO / IO / CQ	VII	TP	S	S	S	S	S	R	S	R	S	S	R	R
MPL3 — Intermediate	VI	T+TP	R	R	R	R	R	R	S	R1	S	S	R	R
TR / ATPL / RL / RO / IO	V	T	S	S	S	S	S	R	R	N	G	S	R	R
MPL2- Basic	IV	T+TP	R	G	G	R	G	R	G	N	G	S	G	R
CR	III	T	R	R	R	R	R	G	R	N	N	S	G	G
IR	II	T	G	G	G	R	G	G	G	N	G	S	G	G
CPL	I	T	R	R	R	R	R	G	R	N	N	S	G	G(S)
MPL1 — Core flying skills	I	T	R	R	R	R	R1	G	G	N	G	S	G	G
PPL	I	T	R	R	R	R	R	G	R	N	N	S	G	R(S)

2. GUIDANCE FOR THE UNDERSTANDING OF THE FSTD SUMMARY MATRIX

2.1 T — See definition of "train" in Part II, Chapter 1, 1.1.

2.2 TP — See definition of "train-to-proficiency" in Part II, Chapter 1, 1.1.

2.3 A device which may be used to demonstrate proficiency may also be used to train for the same task.

2.4 For a definition of the derivative simulator feature fidelity levels R1, G(S) and R(S), see Part II, Chapter 2, 2.2.6 and to the appropriate paragraphs of the FSTD Master Matrix defined in Appendix C to this part.

2.5 For CR, the summary matrix specifies fidelity level S for simulation feature Environment — Navigation despite the fact that there are no specific navigation tasks required. This has been done because FSTDs now have a full navigation database capability.

2.6 For Environment — ATC: All fidelity levels in the summary matrix above are shown greyed out as this feature is currently under development. Guidance on simulated ATC environment and related qualification criteria will remain subject to amendment based on experience (see Part II, Attachment O).

2.7 The MPL concept is a performance-outcome approach to training. The MPL competency framework should accommodate varying degrees of integration of FSTDs and should support the development of a training programme in which appropriate aircraft and FSTDs are used to ensure optimal transfer of learning; trainees move seamlessly through different components of the learning environment to the work environment.

2.8 Devices for MPL Phase 3

MPL Phase 3 learning outcomes are not specific to aeroplane type. The Type VI FSTD example indicated in the summary matrix for MPL Phase 3 offers a means, but not the only means, by which the FSTD specifications support the training outcomes. The task analysis indicates the possibility to meet competency outcomes by a combination of training in the Type V and Type VII FSTD examples. The summary of the Type VI device example is deliberately greyed out to reflect the fact that the training community was, at the time of publication, uncertain about the optimal training device for this phase. The ICAO Annex 1 — *Personnel Licensing* guidance material and the JAR (EASA)-FCL rules also differ in this field; thus, the entire issue is subject to the ICAO "proof of concept" mechanism which collects global MPL experiences as a basis for an update of the MPL Phase 3 device definition when possible.

2.9 Devices for MPL Phase 4

MPL Phase 4 includes, but may not be limited to, an aeroplane type rating. An appropriate combination of device specifications to meet learning outcomes is indicated in the master matrix. The summary matrix however, requires training exclusively in a Type VII device, in compliance with Annex 1, Appendix 3, paragraph 4.

Note.— The Type IV device referred to in Annex 1, Appendix 3, 4.2 d) is equivalent to Type VII in this document.

2.10 Guidance during MPL licence implementation and MPL training programmes introduction

It is suggested that, while the MPL training programmes are being introduced and validated, the highest appropriate level devices are used to facilitate the safe and efficient implementation of the MPL requirements.

Appendix C

FSTD MASTER MATRIX

1. INTRODUCTION

1.1 A master matrix was created which defines the device feature fidelity levels for each of the possible training tasks competencies for each of the fifteen pilot licensing, qualification, rating or training types described in Chapter 4.

1.2 The master matrix consists of two tables:

- one table covering the training types for the "Training" requirement (T); and

- a second table covering the training types for the "Training-to-Proficiency" requirement (TP).

1.3 This is the basic reference material used to define the seven FSTD standard examples and the material contained in this document.

1.4 The FSTD standard examples were reached by a process of rolling up the master matrix individual lines into a single-line definition of a device that is able to cover a number of training tasks.

1.5 The following paragraphs (2 to 16) contain the printouts of the master matrix data for each individual training type of the fifteen types listed in Chapter 4. Each licence or type of training printout of the master matrix data is subdivided into its "Training" requirement (T) and its "Training-to-Proficiency" requirement (TP), if these two requirements are both defined in the master matrix. Each paragraph shows the information available on the level of simulation fidelity required for each device feature and licence or type of training against the individual competency element.

2. MPL1 (MULTI-CREW PILOT LICENCE — PHASE 1, CORE FLYING SKILLS) — MASTER MATRIX DATA — TRAINING (T) — THE INTRODUCTION OF A SPECIFIC TRAINING TASK

MPL1 (T)

Source		Competency Element or Training Task	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
ICAO	2.3	Perform pre-flight checks and cockpit preparation	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	2.4	Perform engine start	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	2.5	Perform taxi out	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	2.6	Manage abnormal and emergency situations	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	3.1	Perform pre-take-off and pre-departure preparation	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	3.2	Perform take-off roll	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	3.3	Perform transition to instrument flight rules	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	3.4	Perform initial climb to flap retraction altitude	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	3.5	Perform rejected take-off	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	3.6	Perform navigation	R	R	N	R	R1	G	G	N	G	S	G	G
ICAO	3.7	Manage abnormal and emergency situations	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	4.2	Complete climb procedures and checklists	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	4.4	Perform systems operation and procedure	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	4.5	Manage abnormal and emergency situations	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	5.1	Monitor navigation accuracy	R	R	N	R	R1	G	G	N	G	S	G	G
ICAO	5.2	Monitor flight progress	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	5.3	Perform descent and approach planning	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	5.4	Perform systems operations and procedures	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	5.5	Manage abnormal and emergency situations	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	6.1	Initiate and manage descent	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	6.2	Monitor and perform en-route and descent navigation	R	R	N	R	R1	G	G	N	G	S	G	G
ICAO	6.5	Perform systems operations and procedures	R	R	N	R	R1	G	G	N	G	N	G	G

MPL1 (T)														
Source		Competency Element or Training Task	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
ICAO	6.6	Manage abnormal and emergency situations	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	7.1	Perform approach in general	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	7.5	Monitor the flight progress	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	7.6	Perform systems operations and procedures	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	7.7	Manage abnormal and emergency situations	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	7.8	Perform go-around/missed approach	R	R	N	R	R1	G	G	N	G	N	G	G
ICAO	8.1	Land the aircraft	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	8.2	Perform systems operations and procedures	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	8.3	Manage abnormal and emergency situations	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	9.1	Perform taxi in and parking	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	9.3	Perform systems operations and procedures	R	R	R	R	R1	G	G	N	G	N	G	G
ICAO	9.4	Manage abnormal and emergency situations	R	R	R	R	R1	G	G	N	G	N	G	G

3. MPL2 (MULTI-CREW PILOT LICENCE — PHASE 2, BASIC) — MASTER MATRIX DATA

3.1 MPL2 — Master matrix data — Training (T) — The introduction of a specific training task

MPL2 (T)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	R	N	G	R	N	N	N	N	N	S	G	N
ICAO	2.2	Provide flight crew and cabin crew briefings	R	N	G	R	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks and cockpit preparation	R	N	G	R	N	N	N	N	G	S	G	N
ICAO	2.4	Perform engine start	R	G	G	R	G	R	G	N	G	N	G	R
ICAO	2.5	Perform taxi out	R	G	G	R	G	R	G	N	G	S	G	R
ICAO	2.6	Manage abnormal and emergency situations	R	G	G	R	G	R	G	N	G	S	G	R
ICAO	2.7	Communicate with cabin crew, passengers and company	R	N	G	R	N	N	N	N	N	S	G	N
ICAO	3.1	Perform pre-take-off and pre-departure preparation	R	G	G	R	G	R	G	N	G	S	G	R
ICAO	3.2	Perform take-off roll	R	G	G	R	G	R	G	N	G	N	G	R
ICAO	3.3	Perform transition to instrument flight rules	R	G	G	R	G	R	G	N	G	S	G	R
ICAO	3.4	Perform initial climb to flap retraction altitude	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	3.5	Perform rejected take-off	R	G	G	R	G	R	G	N	G	N	G	R
ICAO	3.6	Perform navigation	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	3.7	Manage abnormal and emergency situations	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	4.2	Complete climb procedures and checklists	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	4.4	Perform systems operation and procedure	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	4.5	Manage abnormal and emergency situations	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	4.6	Communicate with cabin crew, passengers and company	R	G	N	R	G	R	N	N	N	S	G	N

MPL2 (T)														
Source		Competency Element or Training Task	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
ICAO	5.1	Monitor navigation accuracy	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	5.2	Monitor flight progress	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	5.3	Perform descent and approach planning	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	5.4	Perform systems operations and procedures	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	5.5	Manage abnormal and emergency situations	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	5.6	Communicate with cabin crew, passengers and company	R	G	N	R	G	R	N	N	N	S	G	N
ICAO	6.1	Initiate and manage descent	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	6.2	Monitor and perform en-route and descent navigation	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	6.3	Replanning and update of approach briefing	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	6.4	Perform holding	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	6.5	Perform systems operations and procedures	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	6.6	Manage abnormal and emergency situations	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	6.7	Communicate with cabin crew, passengers and company	R	G	N	R	G	R	N	N	N	S	G	N
ICAO	7.1	Perform approach in general	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	7.2	Perform precision approach	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	7.3	Perform non precision approach	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	7.4	Perform approach with visual reference to ground	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	7.5	Monitor the flight progress	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	7.6	Perform systems operations and procedures	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	7.7	Manage abnormal and emergency situations	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	7.8	Perform go-around/missed approach	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	7.9	Communicate with cabin crew, passengers and company	R	G	N	R	G	R	N	N	N	S	G	N
ICAO	8.1	Land the aircraft	R	G	G	R	G	R	G	N	G	N	G	R
ICAO	8.2	Perform systems operations and procedures	R	G	G	R	G	R	G	N	G	S	G	R

MPL2 (T)													
Source	Competency Element or Training Task	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
ICAO	8.3 Manage abnormal and emergency situations	R	G	G	R	G	R	G	N	G	N	G	R
ICAO	9.1 Perform taxi in and parking	R	G	G	R	G	R	G	N	G	N	G	R
ICAO	9.2 Perform aircraft post-flight operations	R	G	G	R	G	R	G	N	G	N	G	R
ICAO	9.3 Perform systems operations and procedures	R	G	G	R	G	R	G	N	G	S	G	R
ICAO	9.4 Manage abnormal and emergency situations	R	G	G	R	G	R	G	N	G	N	G	R
ICAO	9.5 Communicate with cabin crew, passengers and company	R	N	G	R	N	N	N	N	N	S	G	N
ICAO	Upset prevention, recognition and recovery	R	G	N	R	G	R	G	N	N	S	G	R
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	R	G	N	R	G	R	G	N	N	N	G	N
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	R	G	N	R	G	R	G	N	N	N	G	N
MISC	Limited panel, stabilised climb or descent at Rate 1 turn onto given headings, recovery from unusual attitudes	R	G	N	R	G	R	N	N	N	N	G	N

3.2 MPL2 — Master matrix data — Training-to-Proficiency (TP)

MPL2 (TP)													
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	R	N	R	R	N	N	N	N	N	S	G	N
ICAO	2.2	Provide crew briefings	R	N	R	N	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks cockpit preparation	R	N	R	R	N	N	N	N	G	S	G	N
ICAO	2.4	Perform engine start	R	G	R	R	G	R	G	N	G	N	G	R
ICAO	2.5	Perform taxi out	R	G	R	R	G	R	G	N	G	S	G	R
ICAO	2.6	Manage abnormal and emergency situations	R	G	R	R	G	R	G	N	G	S	G	R
ICAO	2.7	Communicate with cabin crew, passengers and company	R	N	R	R	N	N	N	N	N	S	G	N
ICAO	3.1	Perform pre-take-off preparation	R	G	R	R	G	R	G	N	G	S	G	R
ICAO	3.2	Perform take-off roll	R	G	R	R	G	R	G	N	G	N	G	R
ICAO	3.3	Perform transition to instrument flight rules	R	G	R	R	G	R	G	N	G	S	G	R
ICAO	3.4	Perform initial climb to flap retraction altitude	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	3.5	Perform rejected take-off	R	G	R	R	G	R	G	N	G	N	G	R
ICAO	3.6	Perform navigation	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	3.7	Manage abnormal and emergency situations	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	4.2	Complete climb procedures and checklists	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	4.4	Perform systems operation and procedure	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	4.5	Manage abnormal and emergency situations	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	4.6	Communicate with cabin crew, passengers and company	R	G	N	R	G	R	N	N	N	S	G	N
ICAO	5.1	Monitor navigation accuracy	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	5.2	Monitor flight progress	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	5.3	Perform descent and approach planning	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	5.4	Perform systems operations and procedures	R	G	N	R	G	R	N	N	G	S	G	N

MPL2 (TP)														
Source		Competency Element or Training Task	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
ICAO	5.5	Manage abnormal and emergency situations	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	5.6	Communicate with cabin crew, passengers and company	R	G	N	R	G	R	N	N	N	S	G	N
ICAO	6.1	Initiate and manage descent	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	6.2	Monitor and perform en-route and descent navigation	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	6.3	Replanning and update of approach briefing	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	6.4	Perform holding	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	6.5	Perform systems operations and procedures	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	6.6	Manage abnormal and emergency situations	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	6.7	Communicate with cabin crew, passengers and company	R	G	N	R	G	R	N	N	N	S	G	N
ICAO	7.1	Perform approach in general	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	7.2	Perform precision approach	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	7.3	Perform non precision approach	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	7.4	Perform approach with visual reference	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	7.5	Monitor the flight progress	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	7.6	Perform systems operations and procedures	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	7.7	Manage abnormal and emergency situations	R	G	N	R	G	R	N	N	G	S	G	N
ICAO	7.8	Perform go-around/missed approach	R	G	N	R	G	R	G	N	G	S	G	R
ICAO	7.9	Communicate with cabin crew, passengers and company	R	G	N	R	G	R	N	N	N	S	G	N
ICAO	8.1	Land the aircraft	R	G	R	R	G	R	G	N	G	N	G	R
ICAO	8.2	Perform systems operations and procedures	R	G	R	R	G	R	G	N	G	S	G	R
ICAO	8.3	Manage abnormal and emergency situations	R	G	G	R	G	R	G	N	G	N	G	R
ICAO	9.1	Perform taxi in and parking	R	G	R	R	G	R	G	N	G	N	G	R
ICAO	9.2	Perform aircraft post-flight operations	R	G	R	R	G	R	G	N	G	N	G	R
ICAO	9.3	Perform systems operations and procedures	R	G	R	R	G	R	G	N	G	S	G	R

MPL2 (TP)

Source	Competency Element or Training Task	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
ICAO	9.4 Manage abnormal and emergency situations	R	G	R	R	G	R	G	N	G	N	G	R
ICAO	9.5 Communicate with cabin crew, passengers and company	R	N	R	R	N	N	N	N	N	S	G	N
ICAO	Upset prevention, recognition and recovery	R	G	N	R	G	R	G	N	N	S	G	R
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	R	G	N	R	G	R	G	N	N	N	G	N
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	R	G	N	R	G	R	G	N	N	N	G	N
MISC	Limited panel, stabilised climb or descent at Rate 1 turn onto given headings, recovery from unusual attitudes	R	G	N	R	G	R	N	N	N	N	G	N

4. MPL3 (MULTI-CREW PILOT LICENCE — PHASE 3, INTERMEDIATE) — MASTER MATRIX DATA

4.1 MPL3 — Master matrix data — Training (T) — The introduction of a specific training task

MPL3 (T)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	R	N	R	R	N	N	N	N	N	S	G	N
ICAO	2.2	Provide flight crew and cabin crew briefings	R	N	G	R	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks and cockpit preparation	R	N	R	R	R	N	N	N	S	S	G	R
ICAO	2.4	Perform engine start	R	R	R	R	R	R	N	N	S	S	R	N
ICAO	2.5	Perform taxi out	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	R	R	R	R	R	R	S	N	N	S	R	R
ICAO	3.1	Perform pre-take-off and pre-departure preparation	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	3.2	Perform take-off roll	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	3.5	Perform rejected take-off	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	3.6	Perform navigation	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	3.7	Manage abnormal and emergency situations	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	4.2	Complete climb procedures and checklists	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	4.4	Perform systems operation and procedure	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	4.5	Manage abnormal and emergency situations	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	4.6	Communicate with cabin crew, passengers and company	R	R	N	R	R	R	S	N	N	S	R	R

MPL3 (T)

Source		Competency Element or Training Task	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
ICAO	5.1	Monitor navigation accuracy	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	5.2	Monitor flight progress	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	5.3	Perform descent and approach planning	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	5.4	Perform systems operations and procedures	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	5.5	Manage abnormal and emergency situations	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	5.6	Communicate with cabin crew, passengers and company	R	R	N	R	R	R	S	N	N	S	R	R
ICAO	6.1	Initiate and manage descent	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	6.2	Monitor and perform en-route and descent navigation	R	R	N	R	R	R	N	N	S	S	R	N
ICAO	6.3	Replanning and update of approach briefing	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	6.4	Perform holding	R	R	N	R	R	R	N	N	S	S	R	N
ICAO	6.5	Perform systems operations and procedures	R	R	N	R	R	R	N	N	S	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	R	R	N	R	R	R	N	N	S	S	R	N
ICAO	6.7	Communicate with cabin crew, passengers and company	R	R	N	R	R	R	N	N	N	S	R	N
ICAO	7.1	Perform approach in general	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	7.2	Perform precision approach	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	7.3	Perform non precision approach	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	7.4	Perform approach with visual reference to ground	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	7.5	Monitor the flight progress	R	R	N	R	R	R	N	N	S	S	R	N
ICAO	7.6	Perform systems operations and procedures	R	R	N	R	R	R	N	N	S	S	R	N
ICAO	7.7	Manage abnormal and emergency situations	R	R	N	R	R	R	N	N	S	S	R	N
ICAO	7.8	Perform go-around/missed approach	R	R	N	R	R	R	S	N	S	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	R	R	N	R	R	R	S	N	N	S	R	R

MPL3 (T)														
Source		Competency Element or Training Task	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
ICAO	8.1	Land the aircraft	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	8.2	Perform systems operations and procedures	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	9.1	Perform taxi in and parking	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	9.2	Perform aircraft post-flight operations	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	9.3	Perform systems operations and procedures	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	9.4	Manage abnormal and emergency situations	R	R	R	R	R	R	S	N	S	S	R	R
ICAO	9.5	Communicate with cabin crew, passengers and company	R	R	R	R	R	R	S	N	N	S	R	R

4.2 MPL3 — Master matrix data — Training-to-Proficiency (TP)

MPL3 (TP)

Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	R	N	R	R	N	N	N	N	N	S	G	N
ICAO	2.2	Provide crew briefings	R	N	R	N	N	N	N	N	N	N	N	N
ICAO	2.3	Perform pre-flight checks cockpit preparation	R	N	R	R	R	N	S	R1	S	S	G	R
ICAO	2.4	Perform engine start	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	2.5	Perform taxi out	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	R	R	R	R	R	R	S	R1	N	S	R	R
ICAO	3.1	Perform pre-take-off preparation	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	3.2	Perform take-off roll	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	3.5	Perform rejected take-off	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	3.6	Perform navigation	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	3.7	Manage abnormal and emergency situations	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	4.2	Complete climb procedures and checklists	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	4.4	Perform systems operation and procedure	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	4.5	Manage abnormal and emergency situations	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	4.6	Communicate with cabin crew, passengers and company	R	R	N	R	R	R	S	R1	N	S	R	R
ICAO	5.1	Monitor navigation accuracy	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	5.2	Monitor flight progress	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	5.3	Perform descent and approach planning	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	5.4	Perform systems operations and procedures	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	5.5	Manage abnormal and emergency situations	R	R	N	R	R	R	S	R1	S	S	R	R

MPL3 (TP)														
Source		Competency Element or Training Task	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
ICAO	5.6	Communicate with cabin crew, passengers and company	R	R	N	R	R	R	S	R1	N	S	R	R
ICAO	6.1	Initiate and manage descent	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	6.2	Monitor and perform en-route and descent navigation	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	6.3	Replanning and update of approach briefing	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	6.4	Perform holding	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	6.5	Perform systems operations and procedures	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	6.6	Manage abnormal and emergency situations	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	6.7	Communicate with cabin crew, passengers and company	R	R	N	R	R	R	S	R1	N	S	R	R
ICAO	7.1	Perform approach in general	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	7.2	Perform precision approach	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	7.3	Perform non precision approach	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	7.4	Perform approach with visual reference	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	7.5	Monitor the flight progress	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	7.6	Perform systems operations and procedures	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	7.7	Manage abnormal and emergency situations	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	7.8	Perform go-around/missed approach	R	R	N	R	R	R	S	R1	S	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	R	R	N	R	R	R	S	R1	N	S	R	R
ICAO	8.1	Land the aircraft	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	8.2	Perform systems operations and procedures	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	9.1	Perform taxi in and parking	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	9.2	Perform aircraft post-flight operations	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	9.3	Perform systems operations and procedures	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	9.4	Manage abnormal and emergency situations	R	R	R	R	R	R	S	R1	S	S	R	R
ICAO	9.5	Communicate with cabin crew, passengers and company	R	R	R	R	R	R	S	R1	N	S	R	R

5. MPL4 (MULTI-CREW PILOT LICENCE — PHASE 4, ADVANCED) — MASTER MATRIX DATA

5.1 MPL4 — Master matrix data — Training (T) — The introduction of a specific training task

MPL4 (T)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.2	Provide flight crew and cabin crew briefings	R	G	G	R	G	R	G	N	N	N	G	R
ICAO	2.3	Perform pre-flight checks and cockpit preparation	S	N	R	S	S	R	N	R	S	S	G	N
ICAO	2.4	Perform engine start	S	S	S	S	S	R	N	R	S	S	R	N
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	N	N	S	R	R
ICAO	3.1	Perform pre-take-off and pre-departure preparation	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	S	N	S	S	R	R
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	S	N	S	S	R	R
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	N	N	S	R	R
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	S	N	S	S	R	R

MPL4 (T)

Source		Competency Element or Training Task	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
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	S	N	S	S	R	R
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	S	N	S	S	R	R
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	5.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	N	N	S	R	R
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	N	N	S	S	R	N
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	S	N	S	S	R	R
ICAO	6.4	Perform holding	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.4	Perform approach with visual reference to ground	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	N	N	S	S	R	N
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	N	N	S	R	R
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R

MPL4 (T)

Source	Competency Element or Training Task	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
ICAO	9.1 Perform taxi in and parking	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.2 Perform aircraft post-flight operations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.3 Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.4 Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.5 Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	R	N	S	R	R
ICAO	Upset prevention, recognition and recovery	S	S	N	S	S	R	S	R	S	S	R	R
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	S	S	N	S	S	R	S	R	S	S	R	R
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	S	S	N	S	S	R	S	R	S	S	R	R

5.2 MPL4 — Master matrix data — Training-to-Proficiency (TP)

MPL4 (TP)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.2	Provide crew briefings	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks cockpit preparation	S	N	R	S	S	R	N	N	S	S	G	N
ICAO	2.4	Perform engine start	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	R	N	S	R	R
ICAO	3.1	Perform pre-take-off preparation	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	R	N	S	R	R
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	S	R	S	S	R	R

MPL4 (TP)

Source		Competency Element or Training Task	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
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	5.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	R	N	S	R	R
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	6.4	Perform holding	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	R	N	S	R	R
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.4	Perform approach with visual reference	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	R	N	S	R	R
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.1	Perform taxi in and parking	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.2	Perform aircraft post-flight operations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.3	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R

MPL4 (TP)

Source	Competency Element or Training Task	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
ICAO	9.4 Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.5 Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	R	N	S	R	R
ICAO	Upset prevention, recognition and recovery	S	S	N	S	S	R	S	R	S	S	R	R
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	S	S	N	S	S	R	S	R	S	S	R	R
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	S	S	N	S	S	R	S	R	S	S	R	R

6. IR (INSTRUMENT RATING) — MASTER MATRIX DATA — TRAINING (T) — THE INTRODUCTION OF A SPECIFIC TRAINING TASK

IR (T)														
Source		Competency Element or Training Task	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
ICAO	2.3	Perform pre-flight checks and cockpit preparation	G	N	N	R	N	N	N	N	N	S	G	N
ICAO	3.1	Perform pre-take-off and pre-departure preparation	G	G	G	R	N	G	G	N	G	S	G	G
ICAO	3.2	Perform take-off roll	G	G	G	R	G	G	G	N	N	N	G	G
ICAO	3.3	Perform transition to instrument flight rules	G	G	N	R	G	G	G	N	N	S	G	G
ICAO	3.4	Perform initial climb to flap retraction altitude	G	G	N	R	G	G	N	N	N	S	G	N
ICAO	3.6	Perform navigation	G	G	N	R	G	G	N	N	G	S	G	N
ICAO	3.7	Manage abnormal and emergency situations	G	G	N	R	G	G	N	N	N	S	G	N
ICAO	4.1	Perform standard instrument departure/en-route navigation	G	G	N	R	G	G	N	N	G	S	G	N
ICAO	4.2	Complete climb procedures and checklists	G	G	N	R	G	G	N	N	N	N	G	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	G	G	N	R	G	G	N	N	G	N	G	N
ICAO	4.4	Perform systems operation and procedure	G	G	N	R	G	G	N	N	N	S	G	N
ICAO	4.5	Manage abnormal and emergency situations	G	G	N	R	G	G	N	N	G	S	G	N
ICAO	5.1	Monitor navigation accuracy	G	G	N	R	G	G	N	N	G	S	G	N
ICAO	5.2	Monitor flight progress	G	G	N	R	G	G	N	N	G	S	G	N
ICAO	5.3	Perform descent and approach planning	G	G	N	R	G	G	N	N	N	S	G	N
ICAO	5.4	Perform systems operations and procedures	G	G	N	R	G	G	N	N	N	S	G	N
ICAO	5.5	Manage abnormal and emergency situations	G	G	N	R	G	G	N	N	G	S	G	N
ICAO	6.1	Initiate and manage descent	G	G	N	R	G	G	N	N	G	S	G	N
ICAO	6.2	Monitor and perform en-route and descent navigation	G	G	N	R	G	G	N	N	G	S	G	N
ICAO	6.3	Replanning and update of approach briefing	G	G	N	R	G	G	N	N	G	S	G	N
ICAO	6.4	Perform holding	G	G	N	R	G	G	N	N	G	S	G	N
ICAO	6.5	Perform systems operations and procedures	G	G	N	R	G	G	N	N	N	S	G	N
ICAO	6.6	Manage abnormal and emergency situations	G	G	N	R	G	G	N	N	G	S	G	N
ICAO	7.1	Perform approach in general	G	G	N	R	G	G	G	N	G	S	G	N

IR (T)

Source	Competency Element or Training Task	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
ICAO	7.2 Perform precision approach	G	G	N	R	G	G	G	N	G	S	G	N
ICAO	7.3 Perform non precision approach	G	G	N	R	G	G	G	N	G	S	G	N
ICAO	7.4 Perform approach with visual reference to ground	G	G	N	R	G	G	G	N	G	S	G	G
ICAO	7.5 Monitor the flight progress	G	G	N	R	G	G	N	N	N	S	G	N
ICAO	7.6 Perform systems operations and procedures	G	G	N	R	G	G	N	N	N	S	G	N
ICAO	7.7 Manage abnormal and emergency situations	G	G	N	R	G	G	N	N	G	S	G	N
ICAO	7.8 Perform go-around/missed approach	G	G	N	R	G	G	N	N	G	S	G	N
MISC	Upset prevention, recognition and recovery	G	G	N	R	G	G	N	N	N	N	G	N
FAA	2.2 Flight deck inspection	G	G	G	R	N	N	N	N	N	S	G	N
FAA	2.5 Navigation system setup	G	G	G	R	N	N	N	N	N	S	G	N
FAA	3.5 After landing	G	G	G	R	G	G	G	N	G	S	G	G
FAA	4.2 Instrument with lowest authorized RVR	G	G	G	R	G	G	G	N	N	S	G	G
FAA	7.1 Instrument departure	G	G	N	R	G	G	N	N	G	S	G	N
FAA	7.2 Climb	G	G	N	R	G	G	N	N	N	N	G	N
FAA	7.3 One engine inoperative, en-route	G	G	N	R	G	G	N	N	N	S	G	N
FAA	7.4 En-route navigation	G	G	N	R	G	G	N	N	N	S	G	N
FAA	7.5 Descent	G	G	N	R	G	G	N	N	N	N	G	N
FAA	7.6 Instrument arrival	G	G	N	R	G	G	N	N	G	S	G	N
FAA	7.7 Holding	G	G	N	R	G	G	N	N	G	S	G	N
FAA	7.8 Intercepting and tracking nav. system and DME ARCs	G	G	N	R	G	G	N	N	G	S	G	N
FAA	7.9 Aircraft control by reference to instruments	G	G	N	R	G	G	N	N	N	N	G	N
FAA	7.10 Approach transition	G	G	N	R	G	G	N	N	G	S	G	N
FAA	8.5 Upset recognition and recovery	G	G	N	R	G	G	N	N	N	N	G	N
FAA	9.1 All engines operating — autopilot coupled	G	G	N	R	G	G	N	N	G	S	G	N
FAA	9.2 All engines operating — manually flown	G	G	N	R	G	G	N	N	G	S	G	N
FAA	9.3 One engine inoperative — manually flown	G	G	N	R	G	G	N	N	G	S	G	N
FAA	9.4.1 Approach type: Category II and III	G	G	N	R	G	G	N	N	G	S	G	N

IR (T)													
Source	Competency Element or Training Task	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
FAA	9.4.2 Approach type: Precision groups	G	G	N	R	G	G	N	N	G	S	G	N
FAA	9.4.3 Approach type: Non-precision groups	G	G	N	R	G	G	N	N	G	S	G	N
FAA	9.4.4 Approach type: Ground based radar approach	G	G	N	R	G	G	N	N	G	S	G	N
FAA	11.1 All engines operating	G	G	N	R	G	G	N	N	G	S	G	N
FAA	11.2 One engine inoperative	G	G	N	R	G	G	N	N	G	S	G	N
FAA	11.3 From a circling approach when authorized	G	G	N	R	G	G	R	N	G	S	G	G
FAA	12.4.1 Landing Transition: From a precision approach	G	G	G	R	G	G	G	N	G	S	G	G
FAA	12.4.2 Landing Transition: From a non-precision approach	G	G	G	R	G	G	G	N	G	S	G	G
FAA	12.4.3 Landing Transition: From a visual approach	G	G	G	R	G	G	G	N	G	S	G	G
FAA	12.4.4 Landing Transition: From a circling approach	G	G	G	R	G	G	G	N	G	S	G	G
FAA	12.5 Rejected landing	G	G	G	R	G	G	G	N	G	S	G	G
MISC	Limited panel instruments	G	G	N	R	G	G	N	N	N	N	G	N
MISC	Control of the aeroplane by reference solely to instruments, including: level flight at various speeds and trim settings	G	G	N	R	G	G	N	N	N	N	G	N
MISC	Climbing and descending turns with sustained Rate 1 turn	G	G	N	R	G	G	N	N	N	N	G	N
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	G	G	N	R	G	G	N	N	N	N	G	N
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	G	G	N	R	G	G	N	N	N	N	G	N
MISC	Limited panel, stabilised climb or descent at Rate 1 turn onto given headings, recovery from unusual attitudes	G	G	N	R	G	G	N	N	N	N	G	N
MISC	Approach Transition IAF-FAF	G	G	N	R	G	G	N	N	G	S	G	N

7. PPL (PRIVATE PILOT LICENCE) — MASTER MATRIX DATA — TRAINING (T) THE INTRODUCTION OF A SPECIFIC TRAINING TASK

PPL (T)

Source		Competency Element or Training Task	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
ICAO	2.3	Perform pre-flight checks and cockpit preparation	R	N	G	R	R	N	N	N	N	S	G	N
ICAO	2.4	Perform engine start	R	R	G	R	R	G	G	N	N	N	G	G
ICAO	2.5	Perform taxi out	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	2.6	Manage abnormal and emergency situations	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	3.1	Perform pre-take-off and pre-departure preparation	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	3.2	Perform take-off roll	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	3.4	Perform initial climb to flap retraction altitude	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	3.5	Perform rejected take-off	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	3.6	Perform navigation	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	3.7	Manage abnormal and emergency situations	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	4.2	Complete climb procedures and checklists	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	4.4	Perform systems operation and procedure	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	4.5	Manage abnormal and emergency situations	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	5.1	Monitor navigation accuracy	R	R	N	R	R	G	R	N	N	S	G	S*
ICAO	5.2	Monitor flight progress	R	R	N	R	R	G	R	N	N	S	G	S*
ICAO	5.3	Perform descent and approach planning	R	R	N	R	R	G	R	N	N	N	G	S*
ICAO	5.4	Perform systems operations and procedures	R	R	N	R	R	G	R	N	N	N	G	S*
ICAO	5.5	Manage abnormal and emergency situations	R	R	N	R	R	G	R	N	N	N	G	S*
ICAO	6.1	Initiate and manage descent	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	6.2	Monitor and perform en-route and descent navigation	R	R	N	R	R	G	R	N	N	S	G	G
ICAO	6.5	Perform systems operations and procedures	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	6.6	Manage abnormal and emergency situations	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	7.1	Perform approach in general	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	7.5	Monitor the flight progress	R	R	N	R	R	G	R	N	N	N	G	G

PPL (T)

Source		Competency Element or Training Task	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
ICAO	7.6	Perform systems operations and procedures	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	7.7	Manage abnormal and emergency situations	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	7.8	Perform go-around/missed approach	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	8.1	Land the aircraft	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	8.2	Perform systems operations and procedures	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	8.3	Manage abnormal and emergency situations	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	9.1	Perform taxi in and parking	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	9.2	Perform aircraft post-flight operations	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	9.3	Perform systems operations and procedures	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	9.4	Manage abnormal and emergency situations	R	R	R	R	R	G	R	N	N	N	G	G
FAA	2.2	Flight deck inspection	R	N	N	R	N	N	N	N	N	N	N	N
FAA	2.5	Navigation system setup	R	N	N	R	N	N	N	N	N	N	N	N
FAA	3.1.1	Engine start — Normal	R	R	G	R	R	G	G	N	N	N	G	G
FAA	3.3	Taxi	R	R	R	R	R	G	R	N	N	S	G	G
FAA	3.4	Pre-take-off procedures	R	R	R	R	R	G	G	N	N	N	G	G
FAA	3.5	After landing	R	R	R	R	R	G	G	N	N	N	G	G
FAA	3.6	Parking and securing	R	R	R	R	R	G	G	N	N	S	G	G
FAA	4.1	Normal and crosswind — all engines operating	R	R	R	R	R	G	R	N	N	N	G	G
FAA	4.3.2	With engine failure — between V_r and 500 ft above field elevation	R	R	R	R	R	G	R	N	N	N	G	G
FAA	4.5	Short-field take-off and maximum performance climb	R	R	R	R	R	G	R	N	N	N	G	G
FAA	4.6	Soft-field take-off and climb	R	R	R	R	R	G	R	N	N	N	G	G
FAA	5.1	Steep turns	R	R	N	R	R	G	G	N	N	N	G	G
FAA	5.2	Steep spiral	R	R	N	R	R	G	G	N	N	N	G	G
FAA	6.2	Turns about a point	R	R	N	R	R	G	R	N	N	N	G	G
FAA	6.3	"S-Turns" across a road or section line	R	R	N	R	R	G	R	N	N	N	G	G
FAA	7.2	Climb	R	R	N	R	R	G	G	N	N	N	G	G
FAA	7.4	En-route navigation	R	R	N	R	R	G	R	N	N	S	G	S*
FAA	7.5	Descent	R	R	N	R	R	G	G	N	N	N	G	G
FAA	7.9	Aircraft control by reference to instruments	G	G	N	R	G	G	N	N	N	N	G	N

PPL (T)													
Source	Competency Element or Training Task	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
FAA	8.1.1.1 Stalls — Recovery from: Power-off stalls	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.1.2.1 Recognition/recovery from, approach to stall: Clean configuration	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.1.2.3 Recognition/recovery from, approach to stall: Landing configuration	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.6 Slow flight	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.15 Spin awareness	R	R	N	R	R	G	G	N	N	N	G	G
FAA	10.1 All engines operating (normal)	R	R	N	R	R	G	R	N	N	N	G	G
FAA	12.1 All engines operating	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.2 Crosswind	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.4.3 Landing Transition: From a visual approach	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.5 Rejected landing	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.6 Zero or partial flaps	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.10 Landing from a short-field approach	R	R	R	R	R	G	R	N	N	N	G	G
FAA	13.1 Un-annunciated	R	R	R	R	R	G	G	N	N	N	G	G
FAA	14.1 Fire/smoke in aircraft	R	R	R	R	R	G	G	N	N	N	G	G
FAA	14.2 Un-annunciated fire in flight	R	R	G	R	R	G	G	N	N	N	G	G
FAA	14.4 Emergency descent (maximum rate)	R	R	G	R	R	G	G	N	N	N	G	G
FAA	14.7 Engine fire, severe damage, or separation	R	R	R	R	R	G	G	N	N	N	G	G
MISC	Forced Landing	R	R	R	R	R	G	R	N	N	N	G	G
MISC	Take-off at maximum T/O mass	R	R	R	R	R	G	R	N	N	N	G	G
MISC	Level flight, cruise configuration, control of heading, altitude and airspeed	R	R	N	R	R	G	G	N	N	N	G	G
MISC	Climbing and descending turns with 10°–30° bank	R	R	N	R	R	G	G	N	N	N	G	G
MISC	Recoveries from unusual attitudes	G	G	N	R	G	G	N	N	N	N	G	N
MISC	Upset prevention, recognition and recovery	R	R	N	R	R	N	R	N	N	N	G	G

8. CPL (COMMERCIAL PILOT LICENCE) — MASTER MATRIX DATA — TRAINING (T) — THE INTRODUCTION OF A SPECIFIC TRAINING TASK

CPL (T)														
Source		Competency Element or Training Task	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
ICAO	2.3	Perform pre-flight checks and cockpit preparation	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	2.4	Perform engine start	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	2.5	Perform taxi out	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	2.6	Manage abnormal and emergency situations	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	2.7	Communicate with cabin crew, passengers and company	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	3.1	Perform pre-take-off and pre-departure preparation	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	3.2	Perform take-off roll	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	3.4	Perform initial climb to flap retraction altitude	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	3.5	Perform rejected take-off	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	3.6	Perform navigation	R	R	N	R	R	G	R	N	N	S	G	G
ICAO	3.7	Manage abnormal and emergency situations	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	4.2	Complete climb procedures and checklists	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	4.4	Perform systems operation and procedure	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	4.5	Manage abnormal and emergency situations	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	5.1	Monitor navigation accuracy	R	R	N	R	R	G	R	N	N	S	G	S*
ICAO	5.2	Monitor flight progress	R	R	N	R	R	G	R	N	N	S	G	S*
ICAO	5.3	Perform descent and approach planning	R	R	N	R	R	G	R	N	N	S	G	S*
ICAO	5.4	Perform systems operations and procedures	R	R	N	R	R	G	R	N	N	N	G	S*
ICAO	5.5	Manage abnormal and emergency situations	R	R	N	R	R	G	R	N	N	N	G	S*
ICAO	6.1	Initiate and manage descent	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	6.2	Monitor and perform en-route and descent navigation	R	R	N	R	R	G	R	N	N	S	G	G
ICAO	6.5	Perform systems operations and procedures	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	6.6	Manage abnormal and emergency situations	R	R	N	R	R	G	R	N	N	N	G	G

CPL (T)													
Source	Competency Element or Training Task	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
ICAO	7.1 Perform approach in general	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	7.5 Monitor the flight progress	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	7.6 Perform systems operations and procedures	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	7.7 Manage abnormal and emergency situations	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	7.8 Perform go-around/missed approach	R	R	N	R	R	G	R	N	N	N	G	G
ICAO	8.1 Land the aircraft	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	8.2 Perform systems operations and procedures	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	8.3 Manage abnormal and emergency situations	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	9.1 Perform taxi in and parking	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	9.2 Perform aircraft post-flight operations	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	9.3 Perform systems operations and procedures	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	9.4 Manage abnormal and emergency situations	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	Upset prevention, recognition and recovery	R	R	N	R	R	G	R	N	N	N	G	G
FAA	2.2 Flight deck inspection	R	N	N	R	N	N	N	N	N	N	N	N
FAA	2.5 Navigation system setup	R	N	N	R	N	N	N	N	N	N	N	N
FAA	3.1.1 Engine start — Normal	R	R	G	R	R	G	G	N	N	N	G	G
FAA	3.3 Taxi	R	R	R	R	R	G	R	N	N	S	G	G
FAA	3.4 Pre-take-off procedures	R	R	R	R	R	G	G	N	N	S	G	G
FAA	3.5 After Landing	R	R	R	R	R	G	G	N	N	N	G	G
FAA	3.6 Parking and securing	R	R	R	R	R	G	G	N	N	S	G	G
FAA	4.1 Normal and crosswind — all engines operating	R	R	R	R	R	G	R	N	N	N	G	G
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	R	R	R	R	R	G	R	N	N	N	G	G
FAA	4.5 Short-field take-off and maximum performance climb	R	R	R	R	R	G	R	N	N	N	G	G
FAA	4.6 Soft-field take-off and climb	R	R	R	R	R	G	R	N	N	N	G	G
FAA	5.1 Steep turns	R	R	N	R	R	G	G	N	N	N	G	G
FAA	5.2 Steep spiral	R	R	N	R	R	G	G	N	N	N	G	G
FAA	5.3 Chandelles	R	R	N	R	R	G	R	N	N	N	G	G
FAA	5.4 Lazy eights	R	R	N	R	R	G	R	N	N	N	G	G
FAA	6.1 Eights on Pylons	R	R	N	R	R	G	R	N	N	N	G	G
FAA	7.2 Climb	R	R	N	R	R	G	G	N	N	N	G	G

CPL (T)

Source		Competency Element or Training Task	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
FAA	7.3	One Engine inoperative, en-route	R	R	N	R	R	G	G	N	N	N	G	G
FAA	7.4	En-route navigation	R	R	N	R	R	G	R	N	N	S	G	S*
FAA	7.5	Descent	R	R	N	R	R	G	G	N	N	N	G	G
FAA	7.9	Aircraft control by reference to instruments	G	G	N	R	G	G	N	N	N	N	G	N
FAA	8.1.1.1	Stalls — Recovery from: Power-off stalls	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.1.2.1	Recognition/recovery from, approach to stall: Clean configuration	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.1.2.2	Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.1.2.3	Recognition/recovery from, approach to stall: Landing configuration	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.2.1	Asymmetric thrust: Engine shutdown	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.2.2	Asymmetric thrust: Manoeuvring with one engine inoperative	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.2.3	Asymmetric thrust: Engine restart	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.5	Upset recognition and recovery	R	R	N	R	R	G	R	N	N	N	G	G
FAA	8.6	Slow flight	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.15	Spin awareness	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.16	High altitude operations	R	R	N	R	R	G	G	N	N	N	G	G
FAA	10.1	All engines operating (normal)	R	R	N	R	R	G	R	N	N	N	G	G
FAA	10.2	One engine inoperative	R	R	N	R	R	G	R	N	N	N	G	G
FAA	12.1	All engines operating	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.2	Crosswind	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.3.1	With engine failure: One engine inoperative	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.4.3	Landing Transition: From a visual approach	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.5	Rejected landing	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.6	Zero or partial flaps	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.10	Landing from a short-field approach	R	R	R	R	R	G	R	N	N	N	G	G

CPL (T)													
Source	Competency Element or Training Task	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
FAA	12.11 Accuracy landing	R	R	R	R	R	G	R	N	N	N	G	G
FAA	13.1 Un-annunciated	R	R	R	R	R	G	G	N	N	N	G	G
FAA	14.1 Fire/smoke in aircraft	R	R	R	R	R	G	G	N	N	N	G	G
FAA	14.2 Un-annunciated fire in flight	R	R	G	R	R	G	G	N	N	N	G	G
FAA	14.4 Emergency descent (maximum rate)	R	R	G	R	R	G	G	N	N	N	G	G
FAA	14.7 Engine fire, severe damage, or separation	R	R	R	R	R	G	G	N	N	N	G	G
MISC	Forced Landing	R	R	R	R	R	G	R	N	N	N	G	G
MISC	Take-off at maximum T/O mass	R	R	R	R	R	G	R	N	N	N	G	G
MISC	Level flight, cruise configuration, control of heading, altitude and airspeed	R	R	N	R	R	G	G	N	N	N	G	G
MISC	Climbing and descending turns with 10°–30° bank	R	R	N	R	R	G	G	N	N	N	G	G
MISC	Recoveries from unusual attitudes	R	R	N	R	R	G	G	N	N	N	G	G
MISC	Limited panel instruments	G	G	N	R	G	G	N	N	N	N	G	N
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	R	R	N	R	R	G	R	N	N	N	G	G
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	R	R	N	R	R	G	R	N	N	N	N	N

9. TR (TYPE RATING) — MASTER MATRIX DATA

9.1 TR — Master matrix data — Training (T) — The introduction of a specific training task

TR (T)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.2	Provide flight crew and cabin crew briefings	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks and cockpit preparation	S	N	R	S	S	R	N	N	N	S	G	N
ICAO	2.4	Perform engine start	S	S	R	S	S	R	N	N	G	S	R	N
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	N	S	S	S	R	R	N	N	S	R	R
ICAO	3.1	Perform pre-take-off and pre-departure preparation	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	N	N	G	S	R	N

TR (T)

Source		Competency Element or Training Task	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
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.4	Perform holding	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.4	Perform approach with visual reference to ground	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	S	S	S	S	S	R	R	N	G	S	R	R

TR (T)

Source	Competency Element or Training Task	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
ICAO	9.1 Perform taxi in and parking	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	9.2 Perform aircraft post-flight operations	S	S	S	S	S	R	N	N	G	S	R	N
ICAO	9.3 Perform systems operations and procedures	S	S	S	S	S	R	N	N	G	S	R	N
ICAO	9.4 Manage abnormal and emergency situations	S	S	S	S	S	R	N	N	G	S	G	N
ICAO	9.5 Communicate with cabin crew, passengers and company	S	S	S	S	S	R	N	N	N	S	G	N
ICAO	Upset prevention, recognition and recovery	S	S	N	S	S	R	R	N	G	S	R	R
FAA	2.2 Flight deck inspection	S	N	R	S	S	R	N	N	N	S	G	N
FAA	2.5 Navigation system setup	S	N	R	S	S	R	N	N	N	S	G	N
FAA	3.1.1 Engine start — Normal	S	S	R	S	S	R	N	N	G	S	R	N
FAA	3.1.2 Engine start — Non-normal	S	S	R	S	S	R	N	N	G	S	R	N
FAA	3.2 Pushback or powerback	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.3 Taxi	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.4 Pre-take-off procedures	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.5 After landing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.6 Parking and securing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.1 Normal and crosswind — all engines operating	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.2 Instrument with lowest authorized RVR	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.3.1 With engine failure — between V_1 and V_r	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.4 Rejected with lowest authorized RVR	S	S	S	S	S	R	R	N	G	S	R	R
FAA	7.1 Instrument departure	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.2 Climb	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.3 One engine inoperative, en-route	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.4 En-route navigation	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.5 Descent	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.6 Instrument arrival	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.7 Holding	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.10 Approach transition	S	S	N	S	S	R	N	N	G	S	R	N

TR (T)													
Source	Competency Element or Training Task	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
FAA	8.1.2.1 Recognition/recovery from, approach to stall: Clean configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.3 Recognition/recovery from, approach to stall: Landing configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.4 Recognition/recovery from, approach to stall: Landing configuration with A/P engaged	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.1 Asymmetric thrust: Engine shutdown	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.2 Asymmetric thrust: Manoeuvring with one engine inoperative	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.3 Asymmetric thrust: Engine restart	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.3 Runaway trim and stabilizer	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.4 Jammed trim and stabilizer	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.5 Upset recognition and recovery	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.6 Slow flight	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.7 Turns with and without spoilers	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.8 Stability Augmentation Inoperative	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.10 High sink rate	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.12.1 Wind shear: During take-off	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.12.2 Wind shear: During departure	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.12.3 Wind shear: During approach	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.13 Traffic avoidance (TCAS)	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.14 Terrain avoidance (EGPWS or TAWS	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.16 High altitude operations	S	R	N	S	R	G	G	N	N	N	G	G
FAA	9.1 All engines operating — autopilot coupled.	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.2 All engines operating — manually flown	S	S	N	S	S	R	R	N	G	S	R	R

TR (T)													
Source	Competency Element or Training Task	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
FAA	9.3 One engine inoperative — manually flown	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.1 Approach type: Category II and III	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.2 Approach type: Precision groups	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.3 Approach type: Non-precision groups	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.4Approach type: Ground based radar approach	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.1 All engines operating (normal)	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.2 One engine inoperative.	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.3 Two engines inoperative (3 or 4 engine aeroplane)	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.1 All engines operating	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.2 One engine inoperative	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.3 From a circling approach when authorized	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.4 Descending break-out from PRM approach	S	S	N	S	S	R	R	N	G	S	R	N
FAA	12.1 All engines operating	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.2 Crosswind	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.3.1 With engine failure: One engine inoperative	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.3.2 With engine failure: Two engines inoperative (3 or 4 engine aircraft)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.1 Landing Transition: From a precision approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.2 Landing Transition: From a non-precision approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.3 Landing Transition: From a visual approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.4 Landing Transition: From a circling approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.5 Rejected landing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.6 Zero or partial flaps	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.7 Auto-land	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.8 Enhanced flight vision system (EFVS)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.9 Head-up display (HUD)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	13.2.0 Systems (ATA Chapters)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.1 Air conditioning (21)	S	S	S	S	S	R	R	N	G	N	N	R

TR (T)													
Source	Competency Element or Training Task	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
FAA	13.2.2 Aux power unit (49)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.3 Autopilot (22)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.4 Brakes (32)	S	N	S	S	S	R	R	N	G	N	N	R
FAA	13.2.5 Communications (23)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.6 Doors (52)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.7 Electrical power (24)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.8 Emergency equip. (25)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.9 Engine (72)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.10 Fire protection (26)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.11 Flaps (27)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.12 Flight controls (27)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.13 Fuel (28)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.14 EGPWS/TAWS (34).	S	S	N	S	S	R	R	N	G	N	N	R
FAA	13.2.15 HUD	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.16 Hydraulic power (29)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.17 Ice/rain protection (30)	S	S	S	S	S	R	R	N	G	N	R	R
FAA	13.2.18 Instruments (31)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.19 Landing gear (32)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.20 Navigation (34)	S	S	S	S	S	R	R	N	G	S	N	R
FAA	13.2.21 Oxygen (35)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.22 Pneumatic (36)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.23 Propellers (61)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.24 Stall warning (27)	S	S	N	S	S	R	R	N	G	N	N	R
FAA	13.2.25 Thrust reversers (78).	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.26 Warning systems (various)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.1 Fire/smoke in aircraft	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.2 Un-annunciated fire in flight	S	S	N	S	S	R	N	N	G	N	N	N
FAA	14.4 Emergency descent (maximum rate)	S	S	N	S	S	R	N	N	G	N	R	N
FAA	14.5 Rapid decompression	S	S	N	S	S	R	N	N	G	N	R	N
FAA	14.6 Emergency evacuation	S	N	S	S	S	R	N	N	G	N	R	N
FAA	14.7 Engine fire, severe damage, or separation	S	S	S	S	S	R	R	N	G	N	R	R
FAA	14.8 Landing with degraded flight controls	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.9 Pilot incapacitation	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.10 All other emergencies as in the FCOM	S	S	S	S	S	R	R	N	G	S	R	R
FAA	15.1 Anti-icing and de-icing before take-off	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.2 Structural icing, airborne	S	S	N	S	S	R	R	N	G	N	R	R

TR (T)

Source	Competency Element or Training Task	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
FAA	15.3 Thunderstorm avoidance	S	S	S	S	S	R	R	N	G	S	R	R
FAA	15.4 Contaminated runway operations	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.5 High density altitude runway operations	S	S	S	S	S	R	R	N	G	S	R	R
FAA	15.6 CFIT and terrain avoidance	S	S	N	S	S	R	N	N	G	S	R	N
FAA	15.7 ETOPS procedures	G	G	N	G	N	N	N	N	N	S	G	N
FAA	15.8 Altimeter settings (U.S. and international operations)	S	S	S	S	N	N	N	N	G	N	G	N
FAA	15.9 Air hazard avoidance	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.10 Terrain avoidance (EGPWS or TAWS)	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Fuel dumping	S	S	N	S	S	R	R	N	G	N	N	R
MISC	Take-off at maximum T/O mass	S	S	S	S	S	R	R	N	G	N	R	R
MISC	Low energy awareness	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Level flight, cruise configuration, control of heading, altitude and airspeed	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Climbing and descending turns with 10°–30° bank	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Limited panel instruments	S	S	N	S	S	R	N	N	G	S	N	N
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	S	S	N	S	S	R	R	N	N	N	R	N
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	S	S	N	S	S	R	R	N	N	N	R	R
MISC	Manual precision approach without flight director	S	S	N	S	S	R	N	N	G	S	R	N

9.2 TR — Master matrix data — Training-to-Proficiency (TP)

TR (TP)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.2	Provide crew briefings	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks cockpit preparation	S	N	R	S	S	R	S	R	S	S	R	R
ICAO	2.4	Perform engine start	S	S	R	S	S	R	S	R	S	S	G	R
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	N	S	S	S	R	S	R	N	S	R	R
ICAO	3.1	Perform pre-take-off preparation	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	N	R	G	S	R	N

TR (TP)

Source		Competency Element or Training Task	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
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	G	S	R	R
ICAO	5.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.4	Perform holding	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	G	S	R	R
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.4	Perform approach with visual reference	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	R	N	S	R	R
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.1	Perform taxi in and parking	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.2	Perform aircraft post-flight operations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.3	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.4	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R

TR (TP)

Source	Competency Element or Training Task	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
ICAO	9.5 Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	R	N	S	R	R
ICAO	Upset prevention, recognition and recovery	S	S	N	S	S	R	S	R	S	S	R	R
FAA	2.2 Flight deck inspection	S	S	R	S	S	R	S	R	S	S	R	R
FAA	2.5 Navigation system setup	S	S	R	S	S	R	S	R	S	S	R	R
FAA	3.1.1 Engine start — Normal	S	S	R	S	S	R	S	R	S	S	G	R
FAA	3.1.2 Engine start — Non-normal	S	S	R	S	S	R	S	R	S	S	G	R
FAA	3.2 Pushback or powerback	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.3 Taxi	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.4 Pre-take-off procedures	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.5 After Landing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.6 Parking and securing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.1 Normal and crosswind — all engines operating	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.2 Instrument with lowest authorized RVR	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.3.1 With engine failure — between V_1 and V_r	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.4 Rejected with lowest authorized RVR	S	S	S	S	S	R	S	R	S	S	R	R
FAA	7.1 Instrument departure	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.2 Climb	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.3 One Engine inoperative, en-route	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.4 En-route navigation	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.5 Descent	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.6 Instrument arrival	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.7 Holding	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.10 Approach transition	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.1 Recognition/recovery from, approach to stall: Clean configuration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.3 Recognition/recovery from, approach to stall: Landing configuration	S	S	N	S	S	R	N	R	S	S	R	N

TR (TP)													
Source	Competency Element or Training Task	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
FAA	8.1.2.4 Recognition/recovery from, approach to stall: Landing configuration with A/P engaged	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.1 Asymmetric thrust: Engine shutdown	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.2 Asymmetric thrust: Manoeuvring with one engine inoperative	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.3 Asymmetric thrust: Engine restart	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.3 Runaway trim and stabilizer	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.4 Jammed trim and stabilizer	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.5 Upset recognition and recovery	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.6 Slow flight	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.7 Turns with and without spoilers	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.8 Stability Augmentation Inoperative	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.9 Mach tuck and Mach buffet	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.10 High sink rate	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.11 Flight envelope protection demonstration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.12.1 Wind shear: During take-off	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.12.2 Wind shear: During departure	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.12.3 Wind shear: During approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.13 Traffic avoidance (TCAS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.14 Terrain avoidance (EGPWS or TAWS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.16 High altitude operations	S	N	N	S	N	N	N	N	N	N	N	N
FAA	9.1 All engines operating — autopilot coupled	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.2 All engines operating — manually flown	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.3 One engine inoperative — manually flown	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.1 Approach type: Category II and III	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.2 Approach type: Precision groups	S	S	N	S	S	R	S	R	S	S	R	R

TR (TP)													
Source	Competency Element or Training Task		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
FAA	9.4.3	Approach type: Non-precision groups	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.4	Approach type: Ground based radar approach	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.1	All engines operating (normal)	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.2	One engine inoperative	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.3	Two engines inoperative (3 or 4 engine aeroplane)	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.1	All engines operating	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.2	One engine inoperative	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.3	From a circling approach when authorized	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.4	Descending break-out from PRM approach	S	S	N	S	S	R	S	R	S	S	R	R
FAA	12.1	All engines operating	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.2	Crosswind	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.3.1	With engine failure: One engine inoperative	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.3.2	With engine failure: Two engines inoperative (3 or 4 engine aircraft)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.1	Landing Transition: From a precision approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.2	Landing Transition: From a non-precision approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.3	Landing Transition: From a visual approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.4	Landing Transition: From a circling approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.5	Rejected landing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.6	Zero or partial flaps	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.7	Auto-land	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.8	Enhanced flight vision system (EFVS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.9	Head-up display (HUD)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.1	Un-annunciated	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.0	Systems (ATA Chapters)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.1	Air conditioning (21)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.2	Aux power unit (49)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.3	Autopilot (22)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.4	Brakes (32)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.5	Communications (23)	S	S	S	S	S	R	S	R	S	S	R	R

TR (TP)

Source	Competency Element or Training Task	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
FAA	13.2.6 Doors (52)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.7 Electrical power (24)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.9 Engine (72)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.10 Fire protection (26)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.11 Flaps (27)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.12 Flight controls (27)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.13 Fuel (28)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.14 EGPWS/TAWS (34)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	13.2.15 HUD	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.16 Hydraulic power (29)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.17 Ice/rain protection (30)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.18 Instruments (31)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.19 Landing gear (32)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.20 Navigation (34)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.21 Oxygen (35)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.22 Pneumatic (36)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.23 Propellers (61)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.24 Stall warning (27)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	13.2.25 Thrust reversers (78)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.26 Warning systems (various)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	14.1 Fire/smoke in aircraft	S	S	S	S	S	R	S	R	G	S	R	R
FAA	14.2 Un-annunciated fire in flight	S	S	N	S	S	R	N	R	G	S	R	N
FAA	14.4 Emergency descent (maximum rate)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	14.5 Rapid decompression	S	S	N	S	S	R	S	R	G	S	R	R
FAA	14.6 Emergency evacuation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.7 Engine fire, severe damage, or separation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.8 Landing with degraded flight controls	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.9 Pilot incapacitation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.10 All other emergencies as in the FCOM	S	S	S	S	S	R	N	R	G	N	R	N
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	S	S	N	S	S	R	S	R	S	S	R	R
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	S	S	N	S	S	R	S	R	S	S	R	R
MISC	Manual precision approach without flight director	S	S	N	S	S	R	S	R	S	S	R	R

10. CR (CLASS RATING) — MASTER MATRIX DATA — TRAINING (T) — THE INTRODUCTION OF A SPECIFIC TRAINING TASK

CR (T)														
Source		Competency Element or Training Task	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
ICAO	2.3	Perform pre-flight checks and cockpit preparation	R	N	N	R	N	N	N	N	N	N	N	N
ICAO	2.4	Perform engine start	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	2.5	Perform taxi out	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	2.6	Manage abnormal and emergency situations	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	3.1	Perform pre-take-off and pre-departure preparation	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	3.2	Perform take-off roll	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	3.4	Perform initial climb to flap retraction altitude	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	3.5	Perform rejected take-off	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	3.7	Manage abnormal and emergency situations	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	4.2	Complete climb procedures and checklists	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	4.4	Perform systems operation and procedure	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	4.5	Manage abnormal and emergency situations	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	5.2	Monitor flight progress	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	5.3	Perform descent and approach planning	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	5.4	Perform systems operations and procedures	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	5.5	Manage abnormal and emergency situations	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	6.1	Initiate and manage descent	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	6.5	Perform systems operations and procedures	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	6.6	Manage abnormal and emergency situations	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	7.1	Perform approach in general	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	7.4	Perform approach with visual reference to ground	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	7.5	Monitor the flight progress	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	7.6	Perform systems operations and procedures	R	R	N	R	R	G	G	N	N	N	G	G

CR (T)													
Source	Competency Element or Training Task	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
ICAO	7.7 Manage abnormal and emergency situations	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	7.8 Perform go-around/missed approach	R	R	N	R	R	G	G	N	N	N	G	G
ICAO	8.1 Land the aircraft	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	8.2 Perform systems operations and procedures	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	8.3 Manage abnormal and emergency situations	R	R	R	R	R	G	R	N	N	N	G	G
ICAO	9.1 Perform taxi in and parking	R	R	R	R	R	G	G	N	N	N	G	G
ICAO	9.2 Perform aircraft post-flight operations	R	R	G	R	R	G	G	N	N	N	G	G
ICAO	9.3 Perform systems operations and procedures	R	R	G	R	R	G	G	N	N	N	G	G
ICAO	9.4 Manage abnormal and emergency situations	R	R	G	R	R	G	G	N	N	N	G	G
FAA	2.2 Flight deck inspection	R	N	N	R	N	N	N	N	N	N	N	N
FAA	3.1.1 Engine start — Normal	R	R	G	R	R	G	G	N	N	N	G	G
FAA	3.3 Taxi	R	R	R	R	R	G	G	N	N	N	G	G
FAA	3.4 Pre-take-off procedures	R	R	R	R	R	G	G	N	N	N	G	G
FAA	3.5 After Landing	R	R	R	R	R	G	G	N	N	N	G	G
FAA	3.6 Parking and securing	R	R	G	R	R	G	G	N	N	N	G	G
FAA	4.1 Normal and crosswind — all engines operating	R	R	R	R	R	G	R	N	N	N	G	G
FAA	4.3.1 With engine failure — between V_1 and V_r	R	R	R	R	R	G	R	N	N	N	G	G
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	R	R	R	R	R	G	R	N	N	N	G	G
FAA	4.5 Short-field take-off and maximum performance climb	R	R	R	R	R	G	R	N	N	N	G	G
FAA	5.1 Steep turns	R	R	N	R	R	G	G	N	N	N	G	G
FAA	7.2 Climb	R	R	N	R	R	G	G	N	N	N	G	G
FAA	7.5 Descent	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.1.1.1 Stalls — Recovery from: Power-off stalls	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.1.1.1 Stalls — Recovery from: Power-on stalls	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.1.2.1 Recognition/recovery from, approach to stall: Clean configuration	R	R	N	R	R	G	G	N	N	N	G	G

CR (T)												
Source	Competency Element or Training Task	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
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.1.2.3 Recognition/recovery from, approach to stall: Landing configuration	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.2.1 Asymmetric thrust: Engine shutdown	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.2.2 Asymmetric thrust: Manoeuvring with one engine inoperative	R	R	N	R	R	G	G	N	N	N	G	G
FAA	8.2 Asymmetric thrust: Engine restart	R	R	N	R	R	G	G	N	N	N	G	G
FAA	10.1 All engines operating (normal)	R	R	N	R	R	G	G	N	N	N	G	G
FAA	10.2 One engine inoperative	R	R	N	R	R	G	G	N	N	N	G	G
FAA	11.1 All engines operating	R	R	N	R	R	G	G	N	N	N	G	G
FAA	11.2 One engine inoperative	R	R	N	R	R	G	G	N	N	N	G	G
FAA	12.1 All engines operating	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.2 Crosswind	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.3.1 With engine failure: One engine inoperative	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.5 Rejected landing	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.6 Zero or partial flaps	R	R	R	R	R	G	R	N	N	N	G	G
FAA	12.10 Landing from a short-field approach	R	R	R	R	R	G	R	N	N	N	G	G
MISC	Forced Landing	R	R	R	R	R	G	R	N	N	N	G	G

11. RL (RECURRENT LICENCE (PROFICIENCY)) — MASTER MATRIX DATA

11.1 RL — Master matrix data — Training (T) — The introduction of a specific training task

RL (T)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.2	Provide flight crew and cabin crew briefings	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks and cockpit preparation	S	N	R	S	S	R	N	N	N	S	G	N
ICAO	2.4	Perform engine start	S	S	R	S	S	R	N	N	G	S	R	N
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	S	S	S	S	R	R	N	N	S	R	R
ICAO	3.1	Perform pre-take-off and pre-departure preparation	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	N	N	G	S	R	N

RL (T)														
Source		Competency Element or Training Task	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
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.4	Perform holding	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.4	Perform approach with visual reference to ground	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	S	S	S	S	S	R	R	N	G	S	R	R

RL (T)														
Source		Competency Element or Training Task	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
ICAO	9.1	Perform taxi in and parking	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	9.2	Perform aircraft post-flight operations	S	S	S	S	S	R	N	N	G	S	R	N
ICAO	9.3	Perform systems operations and procedures	S	S	S	S	S	R	N	N	G	S	R	N
ICAO	9.4	Manage abnormal and emergency situations	S	S	S	S	S	R	N	N	G	S	G	N
ICAO	9.5	Communicate with cabin crew, passengers and company	S	S	S	S	S	R	N	N	N	S	G	N
FAA	2.2	Flight deck inspection	S	N	R	S	S	R	N	N	N	S	G	N
FAA	2.5	Navigation system setup	S	N	R	S	S	R	N	N	N	S	G	N
FAA	3.1.1	Engine start — Normal	S	S	R	S	S	R	N	N	G	S	R	N
FAA	3.1.2	Engine start — Non-normal	S	S	R	S	S	R	N	N	G	S	R	N
FAA	3.2	Pushback or powerback	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.3	Taxi	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.4	Pre-take-off procedures	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.5	After landing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.6	Parking and securing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.1	Normal and crosswind — all engines operating	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.2	Instrument with lowest authorized RVR	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.3.1	With engine failure — between V_1 and V_r	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.3.2	With engine failure — between V_r and 500 ft above field elevation	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.4	Rejected with lowest authorized RVR	S	S	S	S	S	R	R	N	G	S	R	R
FAA	7.1	Instrument departure	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.2	Climb	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.3	One Engine inoperative, en-route	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.4	En-route navigation	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.5	Descent	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.6	Instrument arrival	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.7	Holding	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.10	Approach transition	S	S	N	S	S	R	N	N	G	S	R	N
FAA	8.1.2.1	Recognition/recovery from, approach to stall: Clean configuration	S	S	N	S	S	R	N	N	N	N	N	N

RL (T)													
Source	Competency Element or Training Task	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
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.3 Recognition/recovery from, approach to stall: Landing configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.4 Recognition/recovery from, approach to stall: Landing configuration with A/P engaged	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.1 Asymmetric thrust: Engine shutdown	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.2 Asymmetric thrust: Manoeuvring with one engine inoperative	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.3 Asymmetric thrust: Engine restart	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.3 Runaway trim and stabilizer	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.4 Jammed trim and stabilizer	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.5 Upset recognition and recovery	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.6 Slow flight	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.7 Turns with and without spoilers	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.8 Stability Augmentation Inoperative	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.10 High sink rate	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.12.1 Wind shear: During take-off	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.12.2 Wind shear: During departure.	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.12.3 Wind shear: During approach.	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.13 Traffic avoidance (TCAS)	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.14 Terrain avoidance (EGPWS or TAWS)	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.16 High altitude operations	S	R	N	S	R	G	G	N	N	N	G	G
FAA	9.1 All engines operating — autopilot coupled	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.2 All engines operating — manually flown	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.3 One engine inoperative — manually flown	S	S	N	S	S	R	R	N	G	S	R	R

RL (T)

Source	Competency Element or Training Task	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
FAA	9.4.1 Approach type: Category II and III	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.2 Approach type: Precision groups	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.3 Approach type: Non-precision groups	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.4 Approach type: Ground based radar approach	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.1 All engines operating (normal)	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.2 One engine inoperative	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.3 Two engines inoperative (3 or 4 engine aeroplane)	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.1 All engines operating	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.2 One engine inoperative	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.3 From a circling approach when authorized	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.4 Descending break-out from PRM approach	S	S	N	S	S	R	R	N	G	S	R	N
FAA	12.1 All engines operating	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.2 Crosswind	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.3.1 With engine failure: One engine inoperative	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.3.2 With engine failure: Two engines inoperative (3 or 4 engine aircraft)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.1 Landing Transition: From a precision approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.2 Landing Transition: From a non-precision approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.3 Landing Transition: From a visual approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.4 Landing Transition: From a circling approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.5 Rejected landing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.6 Zero or partial flaps	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.7 Auto-land	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.8 Enhanced flight vision system (EFVS)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.9 Head-up display (HUD)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	13.2.0 Systems (ATA Chapters)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.1 Air conditioning (21)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.2 Aux power unit (49)	S	S	S	S	S	R	R	N	G	N	N	R

RL (T)													
Source	Competency Element or Training Task	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
FAA	13.2.3 Autopilot (22)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.4 Brakes (32)	S	N	S	S	S	R	R	N	G	N	N	R
FAA	13.2.5 Communications (23)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.6 Doors (52)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.7 Electrical power (24)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.8 Emergency equip. (25)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.9 Engine (72)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.10 Fire protection (26)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.11 Flaps (27)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.12 Flight controls (27)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.13 Fuel (28)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.14 EGPWS/TAWS (34)	S	S	N	S	S	R	R	N	G	N	N	R
FAA	13.2.15 HUD	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.16 Hydraulic power (29)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.17 Ice/rain protection (30)	S	S	S	S	S	R	R	N	G	N	R	R
FAA	13.2.18 Instruments (31)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.19 Landing gear (32)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.20 Navigation (34)	S	S	S	S	S	R	R	N	G	S	N	R
FAA	13.2.21 Oxygen (35)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.22 Pneumatic (36)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.23 Propellers (61)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.24 Stall warning (27)	S	S	N	S	S	R	R	N	G	N	N	R
FAA	13.2.25 Thrust reversers (78)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.26 Warning systems (various)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.1 Fire/smoke in aircraft	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.2 Un-annunciated fire in flight	S	S	N	S	S	R	N	N	G	N	N	N
FAA	14.4 Emergency descent (maximum rate)	S	S	N	S	S	R	N	N	G	N	R	N
FAA	14.5 Rapid decompression	S	S	N	S	S	R	N	N	G	N	R	N
FAA	14.6 Emergency evacuation	S	N	S	S	S	R	N	N	G	N	R	N
FAA	14.7 Engine fire, severe damage, or separation	S	S	S	S	S	R	R	N	G	N	R	R
FAA	14.8 Landing with degraded flight controls	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.9 Pilot incapacitation	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.10 All other emergencies as in the FCOM	S	S	S	S	S	R	R	N	G	S	R	R
FAA	15.1 Anti-icing and de-icing before take-off	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.2 Structural icing, airborne	S	S	N	S	S	R	R	N	G	N	R	R
FAA	15.3 Thunderstorm avoidance	S	S	S	S	S	R	R	N	G	S	R	R

RL (T)													
Source	Competency Element or Training Task	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
FAA	15.4 Contaminated runway operations	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.5 High density altitude runway operations	S	S	S	S	S	R	R	N	G	S	R	R
FAA	15.6 CFIT and terrain avoidance	S	S	N	S	S	R	N	N	G	S	R	N
FAA	15.7 ETOPS procedures	G	G	N	G	N	N	N	N	N	S	G	N
FAA	15.8 Altimeter settings (U.S. and international operations)	S	S	S	S	N	N	N	N	G	N	G	N
FAA	15.9 Air hazard avoidance	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.10 Terrain avoidance (EGPWS or TAWS)	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Fuel dumping	S	S	N	S	S	R	R	N	G	N	N	R
MISC	Take-off at maximum T/O mass	S	S	S	S	S	R	R	N	G	N	R	R
MISC	Low energy awareness	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Level flight, cruise configuration, control of heading, altitude and airspeed	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Climbing and descending turns with 10°–30° bank	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Limited panel instruments	S	S	N	S	S	R	N	N	G	S	N	N
MISC	Manual precision approach without flight director	S	S	N	S	S	R	N	N	G	S	N	N

11.2 RL — Master matrix data — Training-to-Proficiency (TP)

RL (TP)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.2	Provide crew briefings	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks cockpit preparation	S	S	R	S	S	R	S	R	S	S	R	R
ICAO	2.4	Perform engine start	S	S	R	S	S	R	N	N	S	S	G	R
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	R	N	S	R	R
ICAO	3.1	Perform pre-take-off preparation	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	N	R	S	S	R	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	N	R	S	S	R	R
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	N	R	S	S	R	R
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	N
ICAO	4.6	Communicate with cabin crew, passengers and company	S	N	N	S	N	R	N	R	N	S	R	N
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	N	R	G	S	R	N

RL (TP)														
Source		Competency Element or Training Task	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
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.4	Perform holding	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	N	R	R	S	R	N
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.4	Perform approach with visual reference	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	R	N	S	R	R
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.1	Perform taxi in and parking	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.2	Perform aircraft post-flight operations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.3	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R

RL (TP)													
Source	Competency Element or Training Task	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
ICAO	9.4 Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.5 Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	R	N	S	R	R
FAA	2.2 Flight deck inspection	S	S	R	S	S	R	S	R	S	S	R	R
FAA	2.5 Navigation system setup	S	S	R	S	S	R	S	R	S	S	R	R
FAA	3.1.1 Engine start — Normal	S	S	R	S	S	R	S	R	S	S	G	R
FAA	3.1.2 Engine start — Non-normal	S	S	R	S	S	R	S	R	S	S	G	R
FAA	3.2 Pushback or powerback	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.3 Taxi	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.4 Pre-take-off procedures	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.5 After Landing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.6 Parking and securing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.1 Normal and crosswind — all engines operating	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.2 Instrument with lowest authorized RVR	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.3.1 With engine failure — between V_1 and V_r	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.4 Rejected with lowest authorized RVR	S	S	S	S	S	R	S	R	S	S	R	R
FAA	7.1 Instrument departure	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.2 Climb	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.3 One Engine inoperative, en-route	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.4 En-route navigation	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.5 Descent	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.6 Instrument arrival	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.7 Holding	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.10 Approach transition	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.1 Recognition/recovery from, approach to stall: Clean configuration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	S	S	N	S	S	R	N	R	S	S	R	N

RL (TP)													
Source	Competency Element or Training Task	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
FAA	8.1.2.3 Recognition/recovery from, approach to stall: Landing configuration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.4 Recognition/recovery from, approach to stall: Landing configuration with A/P engaged	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.1 Asymmetric thrust: Engine shutdown	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.2 Asymmetric thrust: Manoeuvring with one engine inoperative	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.3 Asymmetric thrust: Engine restart	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.3 Runaway trim and stabilizer	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.4 Jammed trim and stabilizer	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.5 Upset recognition and recovery	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.6 Slow flight	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.7 Turns with and without spoilers	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.8 Stability Augmentation Inoperative	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.9 Mach tuck and Mach buffet	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.10 High sink rate	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.11 Flight envelope protection demonstration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.12.1 Wind shear: During take-off	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.12.2 Wind shear: During departure	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.12.3 Wind shear: During approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.13 Traffic avoidance (TCAS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.14 Terrain avoidance (EGPWS or TAWS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.16 High altitude operations	S	N	N	S	N	N	N	N	N	N	N	N
FAA	9.1 All engines operating — autopilot coupled	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.2 All engines operating — manually flown	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.3 One engine inoperative — manually flown	S	S	N	S	S	R	S	R	S	S	R	R

RL (TP)													
Source	Competency Element or Training Task	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
FAA	9.4.1 Approach type: Category II and III	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.2 Approach type: Precision groups	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.3 Approach type: Non-precision groups	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.4 Approach type: Ground based radar approach	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.1 All engines operating (normal)	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.2 One engine inoperative	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.3 Two engines inoperative (3 or 4 engine aeroplane)	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.1 All engines operating	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.2 One engine inoperative	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.3 From a circling approach when authorized	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.4 Descending break-out from PRM approach	S	S	N	S	S	R	S	R	S	S	R	R
FAA	12.1 All engines operating	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.2 Crosswind	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.3.1 With engine failure: One engine inoperative	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.3.2 With engine failure: Two engines inoperative (3 or 4 engine aircraft)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.1 Landing Transition: From a precision approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.2 Landing Transition: From a non-precision approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.3 Landing Transition: From a visual approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.4 Landing Transition: From a circling approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.5 Rejected landing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.6 Zero or partial flaps	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.7 Auto-land	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.8 Enhanced flight vision system (EFVS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.9 Head-up display (HUD)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.1 Un-annunciated	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.0 Systems (ATA Chapters)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.1 Air conditioning (21)	S	S	S	S	S	R	S	R	S	S	R	R

RL (TP)													
Source	Competency Element or Training Task	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
FAA	13.2.2 Aux power unit (49)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.3 Autopilot (22)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.4 Brakes (32)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.5 Communications (23)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.6 Doors (52)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.7 Electrical power (24)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.9 Engine (72)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.10 Fire protection (26)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.11 Flaps (27)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.12 Flight controls (27)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.13 Fuel (28)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.14 EGPWS/TAWS (34)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	13.2.15 HUD	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.16 Hydraulic power (29)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.17 Ice/rain protection (30)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.18 Instruments (31)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.19 Landing gear (32)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.20 Navigation (34)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.21 Oxygen (35)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.22 Pneumatic (36)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.23 Propellers (61)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.24 Stall warning (27)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	13.2.25 Thrust reversers (78)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.26 Warning systems (various)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	14.1 Fire/smoke in aircraft	S	S	S	S	S	R	S	R	G	S	R	R
FAA	14.2 Un-annunciated fire in flight	S	S	N	S	S	R	N	R	G	S	R	N
FAA	14.4 Emergency descent (maximum rate)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	14.5 Rapid decompression	S	S	N	S	S	R	S	R	G	S	R	R
FAA	14.6 Emergency evacuation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.7 Engine fire, severe damage, or separation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.8 Landing with degraded flight controls	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.9 Pilot incapacitation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.10 All other emergencies as in the FCOM	S	S	S	S	S	R	N	R	G	N	R	N
MISC	Manual precision approach without flight director	S	S	N	S	S	R	S	R	S	S	N	R

12. RO (RECURRENT OPERATOR (PROFICIENCY)) — MASTER MATRIX DATA

12.1 RO — Master matrix data — Training (T) — The introduction of a specific training task

RO (T)

Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.2	Provide flight crew and cabin crew briefings	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks and cockpit preparation	S	S	R	S	S	N	N	N	G	S	G	R
ICAO	2.4	Perform engine start	S	S	R	S	S	R	N	N	G	S	R	R
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	S	S	S	S	R	R	N	N	S	R	R
ICAO	3.1	Perform pre-take-off and pre-departure preparation	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	N	N	G	S	R	R
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	R
ICAO	4.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N

RO (T)

Source		Competency Element or Training Task	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
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	R
ICAO	5.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.4	Perform holding	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.4	Perform approach with visual reference to ground	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	R	N	G	S	R	R

RO (T)

Source	Competency Element or Training Task	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
ICAO	8.3 Manage abnormal and emergency situations	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	9.1 Perform taxi in and parking	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	9.2 Perform aircraft post-flight operations	S	S	S	S	S	R	N	N	G	S	R	N
ICAO	9.3 Perform systems operations and procedures	S	S	S	S	S	R	N	N	G	S	R	N
ICAO	9.4 Manage abnormal and emergency situations	S	S	S	S	S	R	N	N	G	S	G	N
ICAO	9.5 Communicate with cabin crew, passengers and company	S	S	S	S	S	R	N	N	N	S	G	N
ICAO	Upset prevention, recognition and recovery	S	S	N	S	S	R	R	N	G	S	R	R
FAA	2.2 Flight deck inspection	S	N	R	S	S	R	N	N	N	S	G	N
FAA	2.5 Navigation system setup	S	N	R	S	S	R	N	N	N	S	G	N
FAA	3.1.1 Engine start — Normal	S	S	R	S	S	R	N	N	G	S	R	N
FAA	3.1.2 Engine start — Non-normal	S	S	R	S	S	R	N	N	G	S	R	N
FAA	3.2 Pushback or powerback	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.3 Taxi	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.4 Pre-take-off procedure	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.5 After landing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.6 Parking and securing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.1 Normal and crosswind — all engines operating	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.2 Instrument with lowest authorized RVR	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.3.1 With engine failure — between V_1 and V_r	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.4 Rejected with lowest authorized RVR	S	S	S	S	S	R	R	N	G	S	R	R
FAA	7.1 Instrument departure	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.2 Climb	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.3 One Engine inoperative, en-route	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.4 En-route navigation	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.5 Descent	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.6 Instrument arrival	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.7 Holding	S	S	N	S	S	R	N	N	G	S	R	N

RO (T)

Source	Competency Element or Training Task	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
FAA	7.10 Approach transition	S	S	N	S	S	R	N	N	G	S	R	N
FAA	8.1.2.1 Recognition/recovery from, approach to stall: Clean configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.3 Recognition/recovery from, approach to stall: Landing configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.4 Recognition/recovery from, approach to stall: Landing configuration with A/P engaged	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.1 Asymmetric thrust: Engine shutdown	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.2 Asymmetric thrust: Manoeuvring with one engine inoperative	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.3 Asymmetric thrust: Engine restart	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.3 Runaway trim and stabilizer	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.4 Jammed trim and stabilizer	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.5 Upset recognition and recovery	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.6 Slow flight	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.7 Turns with and without spoilers	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.8 Stability Augmentation Inoperative	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.10 High sink rate	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.12.1 Wind shear: During take-off	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.12.2 Wind shear: During departure	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.12.3 Wind shear: During approach	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.13 Traffic avoidance (TCAS)	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.14 Terrain avoidance (EGPWS or TAWS)	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.16 High altitude operations	S	R	N	S	R	G	G	N	N	N	G	G
FAA	9.1 All engines operating — autopilot coupled	S	S	N	S	S	R	R	N	G	S	R	R

RO (T)													
Source	Competency Element or Training Task	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
FAA	9.2 All engines operating — manually flown	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.3 One engine inoperative — manually flown	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.1 Approach type: Category II and III	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.2 Approach type: Precision groups	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.3 Approach type: Non-precision groups	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.4 Approach type: Ground based radar approach	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.1 All engines operating (normal)	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.2 One engine inoperative	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.3 Two engines inoperative (3 or 4 engine aeroplane)	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.1 All engines operating	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.2 One engine inoperative	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.3 From a circling approach when authorized	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.4 Descending break-out from PRM approach	S	S	N	S	S	R	R	N	G	S	R	N
FAA	12.1 All engines operating	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.2 Crosswind	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.3.1 With engine failure: One engine inoperative	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.3.2 With engine failure: Two engines inoperative (3 or 4 engine aircraft)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.1 Landing Transition: From a precision approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.2 Landing Transition: From a non-precision approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.3 Landing Transition: From a visual approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.4 Landing Transition: From a circling approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.5 Rejected landing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.6 Zero or partial flaps	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.7 Auto-land	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.8 Enhanced flight vision system (EFVS)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.9 Head-up display (HUD)	S	S	S	S	S	R	R	N	G	S	R	R

RO (T)

Source	Competency Element or Training Task	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
FAA	13.2.0 Systems (ATA Chapters)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.1 Air conditioning (21)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.2 Aux power unit (49)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.3 Autopilot (22)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.4 Brakes (32)	S	N	S	S	S	R	R	N	G	N	N	R
FAA	13.2.5 Communications (23)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.6 Doors (52)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.7 Electrical power (24)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.8 Emergency equip. (25)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.9 Engine (72)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.10 Fire protection (26)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.11 Flaps (27)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.12 Flight controls (27)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.13 Fuel (28)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.14 EGPWS/TAWS (34)	S	S	N	S	S	R	R	N	G	N	N	R
FAA	13.2.15 HUD	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.16 Hydraulic power (29)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.17 Ice/rain protection (30)	S	S	S	S	S	R	R	N	G	N	R	R
FAA	13.2.18 Instruments (31)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.19 Landing gear (32)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.20 Navigation (34)	S	S	S	S	S	R	R	N	G	S	N	R
FAA	13.2.21 Oxygen (35)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.22 Pneumatic (36)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.23 Propellers (61)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.24 Stall warning (27)	S	S	N	S	S	R	R	N	G	N	N	R
FAA	13.2.25 Thrust reversers (78)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.26 Warning systems (various)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.1 Fire/smoke in aircraft	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.2 Un-annunciated fire in flight	S	S	N	S	S	R	N	N	G	N	N	N
FAA	14.4 Emergency descent (maximum rate)	S	S	N	S	S	R	N	N	G	N	R	N
FAA	14.5 Rapid decompression	S	S	N	S	S	R	N	N	G	N	R	N
FAA	14.6 Emergency evacuation	S	N	S	S	S	R	N	N	G	N	R	N
FAA	14.7 Engine fire, severe damage, or separation	S	S	S	S	S	R	R	N	G	N	R	R
FAA	14.8 Landing with degraded flight controls	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.9 Pilot incapacitation	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.10 All other emergencies as in the FCOM	S	S	S	S	S	R	R	N	G	S	R	R

RO (T)

Source	Competency Element or Training Task	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
FAA	15.1 Anti-icing and de-icing before take-off	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.2 Structural icing, airborne	S	S	N	S	S	R	R	N	G	N	R	R
FAA	15.3 Thunderstorm avoidance	S	S	S	S	S	R	R	N	G	S	R	R
FAA	15.4 Contaminated runway operations	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.5 High density altitude runway operations	S	S	S	S	S	R	R	N	G	S	R	R
FAA	15.6 CFIT and terrain avoidance	S	S	N	S	S	R	N	N	G	S	R	N
FAA	15.7 ETOPS procedures	G	G	N	G	N	N	N	N	N	S	G	N
FAA	15.8 Altimeter settings (U.S. and international operations)	S	S	S	S	N	N	N	N	G	N	G	N
FAA	15.9 Air hazard avoidance	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.10 Terrain avoidance (EGPWS or TAWS)	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Fuel dumping	S	S	N	S	S	R	R	N	G	N	N	R
MISC	Take-off at maximum T/O mass	S	S	S	S	S	R	R	N	G	N	R	R
MISC	Low energy awareness	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Level flight, cruise configuration, control of heading, altitude and airspeed	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Climbing and descending turns with 10°–30° bank	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Limited panel instruments	S	S	N	S	S	R	N	N	G	S	N	N
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	S	S	N	S	S	R	R	N	N	N	R	N
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	S	S	N	S	S	R	R	N	N	N	R	R
MISC	Manual precision approach without flight director	S	S	N	S	S	R	N	N	G	S	N	N

12.2 RO — Master matrix data — Training-to-Proficiency (TP)

RO (TP)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.2	Provide crew briefings	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks cockpit preparation	S	S	R	S	S	R	S	R	S	S	R	R
ICAO	2.4	Perform engine start	S	S	R	S	S	R	N	N	S	S	G	R
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	S	N	S	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	R	N	S	R	R
ICAO	3.1	Perform pre-take-off preparation	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	N	R	S	S	R	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	N	R	S	S	R	R
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	N	R	G	S	R	N

RO (TP)													
Source		Competency Element or Training Task	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
ICAO	5.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.4	Perform holding	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.4	Perform approach with visual reference	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	R	N	S	R	R
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.1	Perform taxi in and parking	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.2	Perform aircraft post-flight operations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.3	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.4	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.5	Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	R	N	S	R	R

RO (TP)													
Source	Competency Element or Training Task	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
ICAO	Upset prevention, recognition and recovery	S	S	N	S	S	R	S	R	S	S	R	R
FAA	2.2 Flight deck inspection	S	S	R	S	S	R	S	R	S	S	R	R
FAA	2.5 Navigation system setup	S	S	R	S	S	R	S	R	S	S	R	R
FAA	3.1.1 Engine start — Normal	S	S	R	S	S	R	S	R	S	S	G	R
FAA	3.1.2 Engine start — Non-normal	S	S	R	S	S	R	S	R	S	S	G	R
FAA	3.2 Pushback or powerback	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.3 Taxi	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.4 Pre-take-off procedures	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.5 After Landing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.6 Parking and securing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.1 Normal and crosswind — all engines operating	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.2 Instrument with lowest authorized RVR	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.3.1 With engine failure — between V_1 and V_r	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.4 Rejected with lowest authorized RVR	S	S	S	S	S	R	S	R	S	S	R	R
FAA	7.1 Instrument departure	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.2 Climb	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.3 One engine inoperative, en-route	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.4 En-route navigation	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.5 Descent	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.6 Instrument arrival	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.7 Holding	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.10 Approach transition	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.1 Recognition/recovery from, approach to stall: Clean configuration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.3 Recognition/recovery from, approach to stall: Landing configuration	S	S	N	S	S	R	N	R	S	S	R	N

RO (TP)													
Source	Competency Element or Training Task	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
FAA	8.1.2.4 Recognition/recovery from, approach to stall: Landing configuration with A/P engaged	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.1 Asymmetric thrust: Engine shutdown	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.2 Asymmetric thrust: Manoeuvring with one engine inoperative	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.3 Asymmetric thrust: Engine restart	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.3 Runaway trim and stabilizer	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.4 Jammed trim and stabilizer	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.5 Upset recognition and recovery	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.6 Slow flight	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.7 Turns with and without spoilers	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.8 Stability Augmentation Inoperative	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.9 Mach tuck and Mach buffet	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.10 High sink rate	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.11 Flight envelope protection demonstration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.12.1 Wind shear: During take-off	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.12.2 Wind shear: During departure	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.12.3 Wind shear: During approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.13 Traffic avoidance (TCAS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.14 Terrain avoidance (EGPWS or TAWS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.16 High altitude operations	S	N	N	S	N	N	N	N	N	N	N	N
FAA	9.1 All engines operating — autopilot coupled	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.2 All engines operating — manually flown	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.3 One engine inoperative — manually flown	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.1 Approach type: Category II and III	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.2 Approach type: Precision groups	S	S	N	S	S	R	S	R	S	S	R	R

RO (TP)													
Source	Competency Element or Training Task	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
FAA	9.4.3 Approach type: Non-precision groups	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.4 Approach type: Ground based radar approach	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.1 All engines operating (normal)	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.2 One engine inoperative	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.3 Two engines inoperative (3 or 4 engine aeroplane)	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.1 All engines operating	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.2 One engine inoperative	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.3 From a circling approach when authorized	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.4 Descending break-out from PRM approach	S	S	N	S	S	R	S	R	S	S	R	R
FAA	12.1 All engines operating	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.2 Crosswind	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.3.1 With engine failure: One engine inoperative	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.3.2 With engine failure: Two engines inoperative (3 or 4 engine aircraft)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.1 Landing Transition: From a precision approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.2 Landing Transition: From a non-precision approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.3 Landing Transition: From a visual approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.4 Landing Transition: From a circling approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.5 Rejected landing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.6 Zero or partial flaps	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.7 Auto-land	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.8 Enhanced flight vision system (EFVS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.9 Head-up display (HUD)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.1 Un-annunciated	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.0 Systems (ATA Chapters)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.1 Air conditioning (21)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.2 Aux power unit (49)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.3 Autopilot (22)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.4 Brakes (32)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.5 Communications (23)	S	S	S	S	S	R	S	R	S	S	R	R

RO (TP)													
Source	Competency Element or Training Task	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
FAA	13.2.6 Doors (52)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.7 Electrical power (24)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.9 Engine (72)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.10 Fire protection (26)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.11 Flaps (27)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.12 Flight controls (27)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.13 Fuel (28)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.14 EGPWS/TAWS (34)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	13.2.15 HUD	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.16 Hydraulic power (29)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.17 Ice/rain protection (30)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.18 Instruments (31)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.19 Landing gear (32)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.20 Navigation (34)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.21 Oxygen (35)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.22 Pneumatic (36)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.23 Propellers (61)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.24 Stall warning (27)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	13.2.25 Thrust reversers (78)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.26 Warning systems (various)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	14.1 Fire/smoke in aircraft	S	S	S	S	S	R	S	R	G	S	R	R
FAA	14.2 Un-annunciated fire in flight	S	S	N	S	S	R	N	R	G	S	R	N
FAA	14.4 Emergency descent (maximum rate)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	14.5 Rapid decompression	S	S	N	S	S	R	S	R	G	S	R	R
FAA	14.6 Emergency evacuation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.7 Engine fire, severe damage, or separation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.8 Landing with degraded flight controls	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.9 Pilot incapacitation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.10 All other emergencies as in the FCOM	S	S	S	S	S	R	N	R	G	N	R	N
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	S	S	N	S	S	R	S	R	S	S	R	R
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	S	S	N	S	S	R	S	R	S	S	R	R
MISC	Manual precision approach without flight director	S	S	N	S	S	R	S	R	S	S	N	R

13. RE — (RECENCY (TAKE-OFF AND LANDING)) — MASTER MATRIX DATA — TRAINING (T) — THE INTRODUCTION OF A SPECIFIC TRAINING TASK

Re (T)

Source		Competency Element or Training Task	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
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	S	R	N	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	S	R	N	S	R	R
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	S	R	N	S	R	R
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	S	R	N	S	R	R

14. CQ (CONTINUING QUALIFICATION) — MASTER MATRIX DATA — TRAINING-TO-PROFICIENCY (TP)

CQ (TP)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.2	Provide crew briefings	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks cockpit preparation	S	N	R	S	S	R	S	R	S	S	R	R
ICAO	2.4	Perform engine start	S	S	R	S	S	R	S	R	S	S	G	R
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	N	S	S	S	R	S	R	N	S	R	R
ICAO	3.1	Perform pre-take-off preparation	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	N	R	G	S	R	N

CQ (TP)														
Source		Competency Element or Training Task	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
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	G	S	R	R
ICAO	5.6	Communicate with cabin crew, passengers	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.4	Perform holding	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	G	S	R	R
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.4	Perform approach with visual reference	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	R	N	S	R	R
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.1	Perform taxi in and parking	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.2	Perform aircraft post-flight operations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.3	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.4	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R

CQ (TP)												
Source	Competency Element or Training Task	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
ICAO	9.5 Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	R	N	S	R	R
ICAO	Upset prevention, recognition and recovery	S	S	N	S	S	R	S	R	S	S	R	R
FAA	2.2 Flight deck inspection	S	S	R	S	S	R	S	R	S	S	R	R
FAA	2.5 Navigation system setup	S	S	R	S	S	R	S	R	S	S	R	R
FAA	3.1.1 Engine start — Normal	S	S	R	S	S	R	S	R	S	S	G	R
FAA	3.1.2 Engine start — Non-normal	S	S	R	S	S	R	S	R	S	S	G	R
FAA	3.2 Pushback or powerback	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.3 Taxi	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.4 Pre-take-off procedures	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.5 After Landing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.6 Parking and securing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.1 Normal and crosswind — all engines operating	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.2 Instrument with lowest authorized RVR	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.3.1 With engine failure — between V_1 and V_r	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.4 Rejected with lowest authorized RVR	S	S	S	S	S	R	S	R	S	S	R	R
FAA	7.1 Instrument departure	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.2 Climb	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.3 One engine inoperative, en-route	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.4 En-route navigation	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.5 Descent	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.6 Instrument arrival	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.7 Holding	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.10 Approach transition	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.1 Recognition/recovery from, approach to stall: Clean configuration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.3 Recognition/recovery from, approach to stall: Landing configuration	S	S	N	S	S	R	N	R	S	S	R	N

CQ (TP)														
Source	Competency Element or Training Task		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
FAA	8.1.2.4	Recognition/recovery from, approach to stall: Landing configuration with A/P engaged	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.1	Asymmetric thrust: Engine shutdown	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.2	Asymmetric thrust: Manoeuvring with one engine inoperative	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.3	Asymmetric thrust: Engine restart	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.3	Runaway trim and stabilizer	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.4	Jammed trim and stabilizer	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.5	Upset recognition and recovery	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.6	Slow flight	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.7	Turns with and without spoilers	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.8	Stability Augmentation Inoperative	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.9	Mach tuck and Mach buffet	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.10	High sink rate	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.11	Flight envelope protection demonstration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.12.1	Wind shear: During take-off	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.12.2	Wind shear: During departure	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.12.3	Wind shear: During approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.13	Traffic avoidance (TCAS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.14	Terrain avoidance (EGPWS or TAWS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.16	High altitude operations	S	N	N	S	N	N	N	N	N	N	N	N
FAA	9.1	All engines operating — autopilot coupled	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.2	All engines operating — manually flown	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.3	One engine inoperative — manually flown	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.1	Approach type: Category II and III	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.2	Approach type: Precision groups	S	S	N	S	S	R	S	R	S	S	R	R

CQ (TP)													
Source	Competency Element or Training Task	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
FAA	9.4.3 Approach type: Non-precision groups	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.4 Approach type: Ground based radar approach	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.1 All engines operating (normal)	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.2 One engine inoperative	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.3 Two engines inoperative (3 or 4 engine aeroplane)	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.1 All engines operating	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.2 One engine inoperative	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.3 From a circling approach when authorized	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.4 Descending break-out from PRM approach	S	S	N	S	S	R	S	R	S	S	R	R
FAA	12.1 All engines operating	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.2 Crosswind	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.3.1 With engine failure: One engine inoperative	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.3.2 With engine failure: Two engines inoperative (3 or 4 engine aircraft)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.1 Landing Transition: From a precision approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.2 Landing Transition: From a non-precision approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.3 Landing Transition: From a visual approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.4 Landing Transition: From a circling approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.5 Rejected lading	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.6 Zero or partial flaps	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.7 Auto-land	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.8 Enhanced flight vision system (EFVS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.9 Head-up display (HUD)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.1 Un-annunciated	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.0 Systems (ATA Chapters)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.1 Air conditioning (21)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.2 Aux power unit (49)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.3 Autopilot (22)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.4 Brakes (32)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.5 Communications (23)	S	S	S	S	S	R	S	R	S	S	R	R

CQ (TP)													
Source	Competency Element or Training Task	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
FAA	13.2.6 Doors (52)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.7 Electrical power (24)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.9 Engine (72)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.10 Fire protection (26)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.11 Flaps (27)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.12 Flight controls (27)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.13 Fuel (28)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.14 EGPWS/TAWS (34)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	13.2.15 HUD	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.16 Hydraulic power (29)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.17 Ice/rain protection (30)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.18 Instruments (31)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.19 Landing gear (32)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.20 Navigation (34)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.21 Oxygen (35)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.22 Pneumatic (36)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.23 Propellers (61)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.24 Stall warning (27)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	13.2.25 Thrust reversers (78)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.26 Warning systems (various)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	14.1 Fire/smoke in aircraft	S	S	S	S	S	R	S	R	G	S	R	R
FAA	14.2 Un-annunciated fire in flight	S	S	N	S	S	R	N	R	G	S	R	N
FAA	14.4 Emergency descent (maximum rate)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	14.5 Rapid decompression	S	S	N	S	S	R	S	R	G	S	R	R
FAA	14.6 Emergency evacuation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.7 Engine fire, severe damage, or separation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.8 Landing with degraded flight controls	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.9 Pilot incapacitation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.10 All other emergencies as in the FCOM	S	S	S	S	S	R	N	R	G	N	R	N
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	S	S	N	S	S	R	S	R	S	S	R	R
MISC	Manual precision approach without flight director	S	S	N	S	S	R	S	R	S	S	N	R

15. IO (INITIAL OPERATOR) — MASTER MATRIX DATA

15.1 IO — Master matrix data — Training (T) — The introduction of a specific training task

IO (T)

Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	G	S	G	N
ICAO	2.2	Provide flight crew and cabin crew briefings	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks and cockpit preparation	S	N	R	S	S	R	N	N	G	S	G	N
ICAO	2.4	Perform engine start	S	S	R	S	S	R	N	N	G	S	R	N
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	N	S	S	S	R	R	N	N	S	R	R
ICAO	3.1	Perform pre-take-off and pre-departure preparation	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	N	N	G	S	R	N

IO (T)

Source		Competency Element or Training Task	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
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.4	Perform holding	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.4	Perform approach with visual reference to ground	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	S	S	S	S	S	R	R	N	G	S	R	R

IO (T)													
Source	Competency Element or Training Task	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
ICAO	9.1 Perform taxi in and parking	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	9.2 Perform aircraft post-flight operations	S	S	S	S	S	R	N	N	G	S	R	N
ICAO	9.3 Perform systems operations and procedures	S	S	S	S	S	R	N	N	G	S	R	N
ICAO	9.4 Manage abnormal and emergency situations	S	S	S	S	S	R	N	N	G	S	G	N
ICAO	9.5 Communicate with cabin crew, passengers and company	S	S	S	S	S	R	N	N	N	S	G	N
ICAO	Upset prevention, recognition and recovery	S	S	N	S	S	R	R	N	G	S	R	R
FAA	2.2 Flight deck inspection	S	N	R	S	S	R	N	N	N	S	G	N
FAA	2.5 Navigation system setup	S	N	R	S	S	R	N	N	N	S	G	N
FAA	3.1.1 Engine start — Normal	S	S	R	S	S	R	N	N	G	S	R	N
FAA	3.1.2 Engine start — Non-normal	S	S	R	S	S	R	N	N	G	S	R	N
FAA	3.2 Pushback or powerback	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.3 Taxi	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.4 Pre-take-off procedures	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.5 After Landing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.6 Parking and securing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.1 Normal and crosswind — all engines operating	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.2 Instrument with lowest authorized RVR	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.3.1 With engine failure — between V_1 and V_r	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.4 Rejected with lowest authorized RVR	S	S	S	S	S	R	R	N	G	S	R	R
FAA	7.1 Instrument departure	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.2 Climb	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.3 One Engine inoperative, en-route	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.4 En-route navigation	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.5 Descent	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.6 Instrument arrival	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.7 Holding	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.10 Approach transition	S	S	N	S	S	R	N	N	G	S	R	N

IO (T)													
Source	Competency Element or Training Task	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
FAA	8.1.2.1 Recognition/recovery from, approach to stall: Clean configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.3 Recognition/recovery from, approach to stall: Landing configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.4 Recognition/recovery from, approach to stall: Landing configuration with A/P engaged	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.1 Asymmetric thrust: Engine shutdown	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.2 Asymmetric thrust: Manoeuvring with one engine inoperative	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.3 Asymmetric thrust: Engine restart	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.3 Runaway trim and stabilizer	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.4 Jammed trim and stabilizer	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.5 Upset recognition and recovery	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.6 Slow flight	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.7 Turns with and without spoilers	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.8 Stability Augmentation Inoperative	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.10 High sink rate	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.12.1 Wind shear: During take-off	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.12.2 Wind shear: During departure	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.12.3 Wind shear: During approach	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.13 Traffic avoidance (TCAS)	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.14 Terrain avoidance (EGPWS or TAWS)	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.16 High altitude operations	S	R	N	S	R	G	G	N	N	N	G	G
FAA	9.1 All engines operating — autopilot coupled	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.2 All engines operating — manually flown	S	S	N	S	S	R	R	N	G	S	R	R

IO (T)													
Source	Competency Element or Training Task	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
FAA	9.3 One engine inoperative — manually flown	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.1 Approach type: Category II and III	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.2 Approach type: Precision groups	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.3 Approach type: Non-precision groups	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.4 Approach type: Ground based radar approach	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.1 All engines operating (normal)	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.2 One engine inoperative	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.3 Two engines inoperative (3 or 4 engine aeroplane)	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.1 All engines operating	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.2 One engine inoperative	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.3 From a circling approach when authorized	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.4 Descending break-out from PRM approach	S	S	N	S	S	R	R	N	G	S	R	N
FAA	12.1 All engines operating	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.2 Crosswind	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.3.1 With engine failure: One engine inoperative	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.3.2 With engine failure: Two engines inoperative (3 or 4 engine aircraft)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.1 Landing Transition: From a precision approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.2 Landing Transition: From a non-precision approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.3 Landing Transition: From a visual approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.4 Landing Transition: From a circling approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.5 Rejected landing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.6 Zero or partial flaps	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.7 Auto-land	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.8 Enhanced flight vision system (EFVS)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.9 Head-up display (HUD)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	13.2.0 Systems (ATA Chapters)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.1 Air conditioning (21)	S	S	S	S	S	R	R	N	G	N	N	R

IO (T)													
Source	Competency Element or Training Task	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
FAA	13.2.2 Aux power unit (49)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.3 Autopilot (22)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.4 Brakes (32)	S	N	S	S	S	R	R	N	G	N	N	R
FAA	13.2.5 Communications (23)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.6 Doors (52)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.7 Electrical power (24)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.8 Emergency equip. (25)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.9 Engine (72)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.10 Fire protection (26)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.11 Flaps (27)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.12 Flight controls (27)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.13 Fuel (28)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.14 EGPWS/TAWS (34)	S	S	N	S	S	R	R	N	G	N	N	R
FAA	13.2.15 HUD	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.16 Hydraulic power (29)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.17 Ice/rain protection (30)	S	S	S	S	S	R	R	N	G	N	R	R
FAA	13.2.18 Instruments (31)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.19 Landing gear (32)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.20 Navigation (34)	S	S	S	S	S	R	R	N	G	S	N	R
FAA	13.2.21 Oxygen (35)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.22 Pneumatic (36)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.23 Propellers (61)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.24 Stall warning (27)	S	S	N	S	S	R	R	N	G	N	N	R
FAA	13.2.25 Thrust reversers (78)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.26 Warning systems (various)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.1 Fire/smoke in aircraft	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.2 Un-annunciated fire in flight	S	S	N	S	S	R	N	N	G	N	N	N
FAA	14.4 Emergency descent (maximum rate)	S	S	N	S	S	R	N	N	G	N	R	N
FAA	14.5 Rapid decompression	S	S	N	S	S	R	N	N	G	N	R	N
FAA	14.6 Emergency evacuation	S	N	S	S	S	R	N	N	G	N	R	N
FAA	14.7 Engine fire, severe damage, or separation	S	S	S	S	S	R	R	N	G	N	R	R
FAA	14.8 Landing with degraded flight controls	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.9 Pilot incapacitation	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.10 All other emergencies as in the FCOM	S	S	S	S	S	R	R	N	G	S	R	R
FAA	15.2 Structural icing, airborne	S	S	N	S	S	R	R	N	G	N	R	R
FAA	15.3 Thunderstorm avoidance	S	S	S	S	S	R	R	N	G	S	R	R

IO (T)

Source	Competency Element or Training Task	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
FAA	15.4 Contaminated runway operations	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.5 High density altitude runway operations	S	S	S	S	S	R	R	N	G	S	R	R
FAA	15.6 CFIT and terrain avoidance	S	S	N	S	S	R	N	N	G	S	R	N
FAA	15.7 ETOPS procedures	G	G	N	G	N	N	N	N	N	S	G	N
FAA	15.8 Altimeter settings (U.S. and international operations)	S	S	S	S	N	N	N	N	G	N	G	N
FAA	15.9 Air hazard avoidance	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.10 Terrain avoidance (EGPWS or TAWS)	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Fuel dumping	S	S	N	S	S	R	R	N	G	N	N	R
MISC	Take-off at maximum T/O mass	S	S	S	S	S	R	R	N	G	N	R	R
MISC	Low energy awareness	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Level flight, cruise configuration, control of heading, altitude and airspeed	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Climbing and descending turns with 10°–30° bank	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Limited panel instruments	S	S	N	S	S	R	N	N	G	S	N	N
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	S	S	N	S	S	R	R	N	N	N	R	N
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	S	S	N	S	S	R	R	N	N	N	R	R
MISC	Manual precision approach without flight director	S	S	N	S	S	R	N	N	G	S	R	N

15.2 IO — Master matrix data — Training-to-Proficiency (TP)

IO (TP)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.2	Provide crew briefings	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks cockpit preparation	S	N	R	S	S	R	S	N	S	S	R	R
ICAO	2.4	Perform engine start	S	S	R	S	S	R	S	N	S	S	R	R
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	N	S	S	S	R	S	R	N	S	R	R
ICAO	3.1	Perform pre-take-off preparation	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	N	S	R	S	N	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	S	R	S	N	G	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	N	N	S	S	N	N
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.6	Communicate with cabin crew, passengers and company	S	N	N	S	N	R	N	N	N	N	R	R
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	N	R	G	S	R	N

IO (TP)

Source		Competency Element or Training Task	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
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	G	S	R	R
ICAO	5.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.4	Perform holding	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	G	S	R	R
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.4	Perform approach with visual reference	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	R	N	S	R	R
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.1	Perform taxi in and parking	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.2	Perform aircraft post-flight operations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.3	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R

IO (TP)													
Source	Competency Element or Training Task	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
ICAO	9.4 Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.5 Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	R	N	S	R	R
ICAO	Upset prevention, recognition and recovery	S	S	N	S	S	R	S	R	S	S	R	R
FAA	2.2 Flight deck inspection	S	S	R	S	S	R	S	R	S	S	R	R
FAA	2.5 Navigation system setup	S	S	R	S	S	R	S	R	S	S	R	R
FAA	3.1.1 Engine start — Normal	S	S	R	S	S	R	S	R	S	S	G	R
FAA	3.1.2 Engine start — Non-normal	S	S	R	S	S	R	S	R	S	S	G	R
FAA	3.2 Pushback or powerback	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.3 Taxi	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.4 Pre-take-off procedures	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.5 After Landing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.6 Parking and securing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.1 Normal and crosswind — all engines operating	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.2 Instrument with lowest authorized RVR	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.3.1 With engine failure — between V_1 and V_r	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.4 Rejected with lowest authorized RVR	S	S	S	S	S	R	S	R	S	S	R	R
FAA	7.1 Instrument departure	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.2 Climb	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.3 One engine inoperative, en-route	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.4 En-route navigation	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.5 Descent	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.6 Instrument arrival	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.7 Holding	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.10 Approach transition	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.1 Recognition/recovery from, approach to stall: Clean configuration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	S	S	N	S	S	R	N	R	S	S	R	N

IO (TP)														
Source		Competency Element or Training Task	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
FAA	8.1.2.3	Recognition/recovery from, approach to stall: Landing configuration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.4	Recognition/recovery from, approach to stall: Landing configuration with A/P engaged	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.1	Asymmetric thrust: Engine shutdown	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.2	Asymmetric thrust: Manoeuvring with one engine inoperative	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.3	Asymmetric thrust: Engine restart	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.3	Runaway trim and stabilizer	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.4	Jammed trim and stabilizer	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.5	Upset recognition and recovery	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.6	Slow flight	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.7	Turns with and without spoilers	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.8	Stability Augmentation Inoperative	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.9	Mach tuck and Mach buffet	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.10	High sink rate	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.11	Flight envelope protection demonstration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.12.1	Wind shear: During take-off	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.12.2	Wind shear: During departure	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.12.3	Wind shear: During approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.13	Traffic avoidance (TCAS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.14	Terrain avoidance (EGPWS or TAWS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.16	High altitude operations	S	N	N	S	N	N	N	N	N	N	N	N
FAA	9.1	All engines operating — autopilot coupled	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.2	All engines operating — manually flown	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.3	One engine inoperative — manually flown	S	S	N	S	S	R	S	R	S	S	R	R

IO (TP)														
Source		Competency Element or Training Task	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
FAA	9.4.1	Approach type: Category II and III	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.2	Approach type: Precision groups	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.3	Approach type: Non-precision groups	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.4	Approach type: Ground based radar approach	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.1	All engines operating (normal)	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.2	One engine inoperative	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.3	Two engines inoperative (3 or 4 engine aeroplane)	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.1	All engines operating	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.2	One engine inoperative	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.3	From a circling approach when authorized	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.4	Descending break-out from PRM approach	S	S	N	S	S	R	S	R	S	S	R	R
FAA	12.1	All engines operating.	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.2	Crosswind	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.3.1	With engine failure: One engine inoperative	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.3.2	With engine failure: Two engines inoperative (3 or 4 engine aircraft)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.1	Landing Transition: From a precision approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.2	Landing Transition: From a non-precision approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.3	Landing Transition: From a visual approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.4	Landing Transition: From a circling approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.5	Rejected landing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.6	Zero or partial flaps	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.7	Auto-land	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.8	Enhanced flight vision system (EFVS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.9	Head-up display (HUD)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.1	Un-annunciated	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.0	Systems (ATA Chapters)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.1	Air conditioning (21)	S	S	S	S	S	R	S	R	S	S	R	R

IO (TP)

Source	Competency Element or Training Task	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
FAA	13.2.2 Aux power unit (49)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.3 Autopilot (22)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.4 Brakes (32)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.5 Communications (23)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.6 Doors (52)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.7 Electrical power (24)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.9 Engine (72)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.10 Fire protection (26)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.11 Flaps (27)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.12 Flight controls (27)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.13 Fuel (28	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.14 EGPWS/TAWS (34)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	13.2.15 HUD	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.16 Hydraulic power (29)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.17 Ice/rain protection (30)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.18 Instruments (31)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.19 Landing gear (32)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.20 Navigation (34)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.21 Oxygen (35)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.22 Pneumatic (36)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.23 Propellers (61)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.24 Stall warning (27)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	13.2.25 Thrust reversers (78)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.26 Warning systems (various)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	14.1 Fire/smoke in aircraft	S	S	S	S	S	R	S	R	G	S	R	R
FAA	14.2 Un-annunciated fire in flight	S	S	N	S	S	R	N	R	G	S	R	N
FAA	14.4 Emergency descent (maximum rate)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	14.5 Rapid decompression	S	S	N	S	S	R	S	R	G	S	R	R
FAA	14.6 Emergency evacuation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.7 Engine fire, severe damage, or separation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.8 Landing with degraded flight controls	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.9 Pilot incapacitation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.10 All other emergencies as in the FCOM	S	S	S	S	S	R	N	R	G	N	R	N
MISC	Recoveries from unusual attitudes, including sustained 45° bank turns and steep descending turns	S	S	N	S	S	R	S	R	S	S	R	R

IO (TP)													
Source	Competency Element or Training Task	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
MISC	Recovery from approach to stall in level flight, climbing/descending turns and in landing configuration	S	S	N	S	S	R	S	R	S	S	R	R
MISC	Manual precision approach without flight director	S	S	N	S	S	R	S	R	S	S	R	R

16. ATPL (AIRLINE TRANSPORT PILOT LICENCE) — MASTER MATRIX DATA

16.1 ATPL — Master matrix data — Training (T) — The introduction of a specific training task

ATPL (T)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.2	Provide flight crew and cabin crew briefings	S	S	S	S	S	R	S	N	N	S	R	R
ICAO	2.3	Perform pre-flight checks and cockpit preparation	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	2.4	Perform engine start	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	S	S	S	S	R	R	N	N	S	R	R
ICAO	3.1	Perform pre-take-off and pre-departure preparation	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	4.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	N	N	G	S	R	N

ATPL (T)

Source		Competency Element or Training Task	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
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	5.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.4	Perform holding	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.4	Perform approach with visual reference to ground	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	N	N	G	S	R	N
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	R	N	G	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	N	N	S	R	N
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	S	S	S	S	S	R	R	N	G	S	R	R

ATPL (T)

Source	Competency Element or Training Task	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
ICAO	9.1 Perform taxi in and parking	S	S	S	S	S	R	R	N	G	S	R	R
ICAO	9.2 Perform aircraft post-flight operations	S	S	S	S	S	R	N	N	G	S	R	N
ICAO	9.3 Perform systems operations and procedures	S	S	S	S	S	R	N	N	G	S	R	N
ICAO	9.4 Manage abnormal and emergency situations	S	S	S	S	S	R	N	N	G	S	G	N
ICAO	9.5 Communicate with cabin crew, passengers and company	S	S	S	S	S	R	N	N	N	S	G	N
FAA	2.2 Flight deck inspection	S	N	R	S	S	R	N	N	N	S	G	N
FAA	2.5 Navigation system setup	S	N	R	S	S	R	N	N	N	S	G	N
FAA	3.1.1 Engine start — Normal	S	S	R	S	S	R	N	N	G	S	R	N
FAA	3.1.2 Engine start — Non-normal	S	S	R	S	S	R	N	N	G	S	R	N
FAA	3.2 Pushback or powerback	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.3 Taxi	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.4 Pre-take-off procedures	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.5 After Landing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	3.6 Parking and securing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.1 Normal and crosswind — all engines operating	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.2 Instrument with lowest authorized RVR	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.3.1 With engine failure — between V_1 and V_r	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	S	S	S	S	S	R	R	N	G	S	R	R
FAA	4.4 Rejected with lowest authorized RVR	S	S	S	S	S	R	R	N	G	S	R	R
FAA	7.1 Instrument departure	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.2 Climb	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.3 One Engine inoperative, en-route	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.4 En-route navigation	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.5 Descent	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.6 Instrument arrival	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.7 Holding	S	S	N	S	S	R	N	N	G	S	R	N
FAA	7.10 Approach transition	S	S	N	S	S	R	N	N	G	S	R	N
FAA	8.1.2.1 Recognition/recovery from, approach to stall: Clean configuration	S	S	N	S	S	R	N	N	N	N	N	N

ATPL (T)

Source	Competency Element or Training Task	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
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.3 Recognition/recovery from, approach to stall: Landing configuration	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.1.2.4 Recognition/recovery from, approach to stall: Landing configuration with A/P engaged	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.1 Asymmetric thrust: Engine shutdown	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.2 Asymmetric thrust: Manoeuvring with one engine inoperative	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.2.3 Asymmetric thrust: Engine restart	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.3 Runaway trim and stabilizer	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.4 Jammed trim and stabilizer	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.5 Upset recognition and recovery	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.6 Slow flight	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.7 Turns with and without spoilers	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.8 Stability Augmentation Inoperative	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.10 High sink rate	S	S	N	S	S	R	N	N	N	N	N	N
FAA	8.12.1 Wind shear: During take-off	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.12.2 Wind shear: During departure	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.12.3 Wind shear: During approach	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.13 Traffic avoidance (TCAS)	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.14 Terrain avoidance (EGPWS or TAWS)	S	S	S	S	S	R	R	N	N	N	R	R
FAA	8.16 High altitude operations	S	R	N	S	R	G	G	N	N	N	G	G
FAA	9.1 All engines operating — autopilot coupled	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.2 All engines operating — manually flown	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.3 One engine inoperative — manually flown	S	S	N	S	S	R	R	N	G	S	R	R

ATPL (T)														
Source		Competency Element or Training Task	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
FAA	9.4.1	Approach type: Category II and III	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.2	Approach type: Precision groups	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.3	Approach type: Non-precision groups	S	S	N	S	S	R	R	N	G	S	R	R
FAA	9.4.4	Approach type: Ground based radar approach	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.1	All engines operating (normal)	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.2	One engine inoperative	S	S	N	S	S	R	R	N	G	S	R	R
FAA	10.3	Two engines inoperative (3 or 4 engine aeroplane)	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.1	All engines operating	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.2	One engine inoperative	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.3	From a circling approach when authorized	S	S	N	S	S	R	R	N	G	S	R	R
FAA	11.4	Descending break-out from PRM approach	S	S	N	S	S	R	R	N	G	S	R	N
FAA	12.1	All engines operating	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.2	Crosswind	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.3.1	With engine failure: One engine inoperative	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.3.2	With engine failure: Two engines inoperative (3 or 4 engine aircraft)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.1	Landing Transition: From a precision approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.2	Landing Transition: From a non-precision approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.3	Landing Transition: From a visual approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.4.4	Landing Transition: From a circling approach	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.5	Rejected landing	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.6	Zero or partial flaps	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.7	Auto-land	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.8	Enhanced flight vision system (EFVS)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	12.9	Head-up display (HUD)	S	S	S	S	S	R	R	N	G	S	R	R
FAA	13.2.0	Systems (ATA Chapters)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.1	Air conditioning (21)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.2	Aux power unit (49)	S	S	S	S	S	R	R	N	G	N	N	R

ATPL (T)

Source	Competency Element or Training Task	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
FAA	13.2.3 Autopilot (22)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.4 Brakes (32)	S	N	S	S	S	R	R	N	G	N	N	R
FAA	13.2.5 Communications (23)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.6 Doors (52)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.7 Electrical power (24)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.8 Emergency equip. (25)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.9 Engine (72)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.10 Fire protection (26)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.11 Flaps (27)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.12 Flight controls (27)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.13 Fuel (28)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.14 EGPWS/TAWS (34)	S	S	N	S	S	R	R	N	G	N	N	R
FAA	13.2.15 HUD	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.16 Hydraulic power (29)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.17 Ice/rain protection (30)	S	S	S	S	S	R	R	N	G	N	R	R
FAA	13.2.18 Instruments (31)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.19 Landing gear (32)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.20 Navigation (34)	S	S	S	S	S	R	R	N	G	S	N	R
FAA	13.2.21 Oxygen (35)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.22 Pneumatic (36)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.23 Propellers (61)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.24 Stall warning (27)	S	S	N	S	S	R	R	N	G	N	N	R
FAA	13.2.25 Thrust reversers (78)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	13.2.26 Warning systems (various)	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.1 Fire/smoke in aircraft	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.2 Un-annunciated fire in flight	S	S	N	S	S	R	N	N	G	N	N	N
FAA	14.4 Emergency descent (maximum rate)	S	S	N	S	S	R	N	N	G	N	R	N
FAA	14.5 Rapid decompression	S	S	N	S	S	R	N	N	G	N	R	N
FAA	14.6 Emergency evacuation	S	N	S	S	S	R	N	N	G	N	R	N
FAA	14.7 Engine fire, severe damage, or separation	S	S	S	S	S	R	R	N	G	N	R	R
FAA	14.8 Landing with degraded flight control	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.9 Pilot incapacitation	S	S	S	S	S	R	R	N	G	N	N	R
FAA	14.10 All other emergencies as in the FCOM	S	S	S	S	S	R	R	N	G	S	R	R
FAA	15.1 Anti-icing and de-icing before take-off	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.2 Structural icing, airborne	S	S	N	S	S	R	R	N	G	N	R	R
FAA	15.3 Thunderstorm avoidance	S	S	S	S	S	R	R	N	G	S	R	R

ATPL (T)													
Source	Competency Element or Training Task	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
FAA	15.4 Contaminated runway operations	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.5 High density altitude runway operations	S	S	S	S	S	R	R	N	G	S	R	R
FAA	15.6 CFIT and terrain avoidance	S	S	N	S	S	R	N	N	G	S	R	N
FAA	15.7 ETOPS procedures	G	G	N	G	N	N	N	N	N	S	G	N
FAA	15.8 Altimeter settings (U.S. and international operations)	S	S	S	S	N	N	N	N	G	N	G	N
FAA	15.9 Air hazard avoidance	S	S	S	S	S	R	R	N	G	N	R	R
FAA	15.10 Terrain avoidance (EGPWS or TAWS)	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Fuel dumping	S	S	N	S	S	R	R	N	G	N	N	R
MISC	Take-off at maximum T/O mass	S	S	S	S	S	R	R	N	G	N	R	R
MISC	Low energy awareness	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Level flight, cruise configuration, control of heading, altitude and airspeed	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Climbing and descending turns with 10°–30° bank	S	S	N	S	S	R	N	N	G	N	N	N
MISC	Limited panel instruments	S	S	N	S	S	R	N	N	G	S	N	N
MISC	Manual precision approach without flight director	S	S	N	S	S	R	N	N	G	S	N	N

16.2 ATPL — Master matrix data — Training-to-Proficiency (TP)

ATPL (TP)														
Source		Competency Element or Training Task	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
ICAO	2.1	Perform dispatch duties	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.2	Provide crew briefings	S	N	R	S	N	N	N	N	N	S	G	N
ICAO	2.3	Perform pre-flight checks cockpit preparation	S	S	R	S	S	R	S	R	S	S	R	R
ICAO	2.4	Perform engine start	S	S	R	S	S	R	S	R	S	S	G	R
ICAO	2.5	Perform taxi out	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.6	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	2.7	Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	R	N	S	R	R
ICAO	3.1	Perform pre-take-off preparation	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.2	Perform take-off roll	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.3	Perform transition to instrument flight rules	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.4	Perform initial climb to flap retraction altitude	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	3.5	Perform rejected take-off	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	3.6	Perform navigation	S	S	N	S	S	R	N	N	S	S	R	N
ICAO	3.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.1	Perform standard instrument departure/en-route navigation	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.2	Complete climb procedures and checklists	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.3	Modify climb speeds, rate of climb and cruise altitude	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.4	Perform systems operation and procedure	S	S	N	S	S	R	N	R	S	S	R	N
ICAO	4.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	4.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	5.1	Monitor navigation accuracy	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.2	Monitor flight progress	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.3	Perform descent and approach planning	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	5.4	Perform systems operations and procedures	S	S	N	S	S	R	N	R	G	S	R	N

ATPL (TP)														
Source		Competency Element or Training Task	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
ICAO	5.5	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	G	S	R	R
ICAO	5.6	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	6.1	Initiate and manage descent	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.2	Monitor and perform en-route and descent navigation	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.3	Replanning and update of approach briefing	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.4	Perform holding	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.5	Perform systems operations and procedures	S	S	N	S	S	R	N	R	G	S	R	N
ICAO	6.6	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	G	S	R	R
ICAO	6.7	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	N	R	N	S	R	N
ICAO	7.1	Perform approach in general	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.2	Perform precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.3	Perform non precision approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.4	Perform approach with visual reference	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.5	Monitor the flight progress	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.6	Perform systems operations and procedures	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.7	Manage abnormal and emergency situations	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.8	Perform go-around/missed approach	S	S	N	S	S	R	S	R	S	S	R	R
ICAO	7.9	Communicate with cabin crew, passengers and company	S	S	N	S	S	R	S	R	N	S	R	R
ICAO	8.1	Land the aircraft	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.2	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	8.3	Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.1	Perform taxi in and parking	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.2	Perform aircraft post-flight operations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.3	Perform systems operations and procedures	S	S	S	S	S	R	S	R	S	S	R	R

ATPL (TP)

Source	Competency Element or Training Task	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
ICAO	9.4 Manage abnormal and emergency situations	S	S	S	S	S	R	S	R	S	S	R	R
ICAO	9.5 Communicate with cabin crew, passengers and company	S	S	S	S	S	R	S	R	N	S	R	R
FAA	2.2 Flight deck inspection	S	S	R	S	S	R	S	R	S	S	R	R
FAA	2.5 Navigation system setup	S	S	R	S	S	R	S	R	S	S	R	R
FAA	3.1.1 Engine start — Normal	S	S	R	S	S	R	S	R	S	S	G	R
FAA	3.1.2 Engine start — Non-normal	S	S	R	S	S	R	S	R	S	S	G	R
FAA	3.2 Pushback or powerback	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.3 Taxi	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.4 Pre-take-off procedures	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.5 After Landing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	3.6 Parking and securing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.1 Normal and crosswind — all engines operating	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.2 Instrument with lowest authorized RVR	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.3.1 With engine failure — between V_1 and V_r	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.3.2 With engine failure — between V_r and 500 ft above field elevation	S	S	S	S	S	R	S	R	S	S	R	R
FAA	4.4 Rejected with lowest authorized RVR	S	S	S	S	S	R	S	R	S	S	R	R
FAA	7.1 Instrument departure	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.2 Climb	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.3 One engine inoperative, en-route	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.4 En-route navigation	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.5 Descent	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.6 Instrument arrival	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.7 Holding	S	S	N	S	S	R	N	R	S	S	R	N
FAA	7.10 Approach transition	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.1 Recognition/recovery from, approach to stall: Clean configuration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.2 Recognition/recovery from, approach to stall: Take-off and manoeuvring configuration	S	S	N	S	S	R	N	R	S	S	R	N

ATPL (TP)													
Source	Competency Element or Training Task	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
FAA	8.1.2.3 Recognition/recovery from, approach to stall: Landing configuration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.1.2.4 Recognition/recovery from, approach to stall: Landing configuration with A/P engaged	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.1 Asymmetric thrust: Engine shutdown	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.2 Asymmetric thrust: Manoeuvring with one engine inoperative	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.2.3 Asymmetric thrust: Engine restart	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.3 Runaway trim and stabilizer	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.4 Jammed trim and stabilizer	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.5 Upset recognition and recovery	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.6 Slow flight	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.7 Turns with and without spoilers	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.8 Stability Augmentation Inoperative	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.9 Mach tuck and Mach buffet	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.10 High sink rate	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.11 Flight envelope protection demonstration	S	S	N	S	S	R	N	R	S	S	R	N
FAA	8.12.1 Wind shear: During take off	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.12.2 Wind shear: During departure	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.12.3 Wind shear: During approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.13 Traffic avoidance (TCAS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.14 Terrain avoidance (EGPWS or TAWS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	8.16 High altitude operations	S	N	N	S	N	N	N	N	N	N	N	N
FAA	9.1 All engines operating — autopilot coupled	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.2 All engines operating — manually flown	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.3 One engine inoperative — manually flown	S	S	N	S	S	R	S	R	S	S	R	R

ATPL (TP)														
Source		Competency Element or Training Task	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
FAA	9.4.1	Approach type: Category II and III	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.2	Approach type: Precision groups	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.3	Approach type: Non-precision groups	S	S	N	S	S	R	S	R	S	S	R	R
FAA	9.4.4	Approach type: Ground based radar approach	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.1	All engines operating (normal)	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.2	One engine inoperative	S	S	N	S	S	R	S	R	S	S	R	R
FAA	10.3	Two engines inoperative (3 or 4 engine aeroplane)	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.1	All engines operating	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.2	One engine inoperative	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.3	From a circling approach when authorized	S	S	N	S	S	R	S	R	S	S	R	R
FAA	11.4	Descending break-out from PRM approach	S	S	N	S	S	R	S	R	S	S	R	R
FAA	12.1	All engines operating	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.2	Crosswind	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.3.1	With engine failure: One engine inoperative	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.3.2	With engine failure: Two engines inoperative (3 or 4 engine aircraft)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.1	Landing Transition: From a precision approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.2	Landing Transition: From a non-precision approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.3	Landing Transition: From a visual approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.4.4	Landing Transition: From a circling approach	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.5	Rejected landing	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.6	Zero or partial flaps	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.7	Auto-land	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.8	Enhanced flight vision system (EFVS)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	12.9	Head-up display (HUD)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.1	Un-annunciated	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.0	Systems (ATA Chapters)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.1	Air conditioning (21)	S	S	S	S	S	R	S	R	S	S	R	R

ATPL (TP)													
Source	Competency Element or Training Task	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
FAA	13.2.2 Aux power unit (49)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.3 Autopilot (22)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.4 Brakes (32)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.5 Communications (23)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.6 Doors (52)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.7 Electrical power (24)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.9 Engine (72)	S	S	S	S	S	R	S	R	S	S	R	R
FAA	13.2.10 Fire protection (26)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.11 Flaps (27)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.12 Flight controls (27)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.13 Fuel (28)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.14 EGPWS/TAWS (34)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	13.2.15 HUD	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.16 Hydraulic power (29)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.17 Ice/rain protection (30)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.18 Instruments (31)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.19 Landing gear (32)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.20 Navigation (34)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.21 Oxygen (35)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.22 Pneumatic (36)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.23 Propellers (61)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.24 Stall warning (27)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	13.2.25 Thrust reversers (78)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	13.2.26 Warning systems (various)	S	S	S	S	S	R	S	R	G	S	R	R
FAA	14.1 Fire/smoke in aircraft	S	S	S	S	S	R	S	R	G	S	R	R
FAA	14.2 Un-annunciated fire in flight	S	S	N	S	S	R	N	R	G	S	R	N
FAA	14.4 Emergency descent (maximum rate)	S	S	N	S	S	R	S	R	G	S	R	R
FAA	14.5 Rapid decompression	S	S	N	S	S	R	S	R	G	S	R	R
FAA	14.6 Emergency evacuation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.7 Engine fire, severe damage, or separation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.8 Landing with degraded flight controls	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.9 Pilot incapacitation	S	S	S	S	S	R	N	R	G	N	R	N
FAA	14.10 All other emergencies as in the FCOM	S	S	S	S	S	R	N	R	G	N	R	N
MISC	Manual precision approach without flight director	S	S	N	S	S	R	S	R	S	S	R	R

MANUAL OF CRITERIA FOR THE QUALIFICATION OF FLIGHT SIMULATION TRAINING DEVICES

Volume I

Aeroplanes

Part II

Flight Simulation Training Device Criteria

Chapter 1

GLOSSARY OF TERMS, ABBREVIATIONS AND UNITS

1.1 GLOSSARY OF TERMS

The terms used in this manual have the following meanings:

Active force feedback. In the context of a Flight Controls System, active force feedback indicates 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.

Additional engines/avionics. An FSTD which has simulation of more than one engine/avionics fit.

Aeroplane performance data. Data used to certify the aeroplane performance. The data are generally for a normalized representation of the aeroplane fleet with a margin to ensure that the values represent the least performing case.

Note.— An example is the data used to generate Aeroplane Flight Manual (AFM) or Flight Planning and Cruise Control Manual (FPCCM) values.

Air Operator. A person, organization or enterprise engaged in or offering to engage in an aircraft operation.

Note.— See definition of "operator" in Annex 6 — Operation of Aircraft.

Airport. 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.

Note.— ICAO normally uses the term "aerodrome" but the term "airport" is also used throughout this document.

Airport clutter. *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.*

Airspeed. Calibrated airspeed unless otherwise specified (knots).

Alpha/beta envelope plot. 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.

Note.— The type of envelope being plotted varies. For example, a plot may be used to depict various FSTD training envelopes for flaps up and down cases: the envelope validated by flight test data, the envelope defined by wind tunnel or analytical data and the envelope defined by extrapolation of those datasets (see example plots in Attachment P).

Alternate engines/avionics. An FSTD which has simulation of a replacement engine/avionics fit.

Altitude. Pressure altitude (ft) unless otherwise specified.

Approved data. Aeroplane data collected by application of good engineering practice and accepted for use by the CAA. The preferred data sources are the aeroplane manufacturers and/or original equipment manufacturers; however, data supplied by other qualified sources may be considered.

Note.— For additional guidance, see the attachments and related reading material listed in Chapter 2, 2.3.

Approved subjective development. Use of a documented process prior to the initial evaluation, acceptable to the CAA, to resolve issues with approved data by use of specific measurements on the aeroplane and/or documentation for aeroplane operation and/or judgement by qualified personnel.

Approved training organization (ATO). A flight crew training organization formally recognized by a CAA to deliver training.

Approved use. The ability to complete the training and testing or checking tasks as prescribed in this manual.

ATA Chapters. A common industry referencing standard for aircraft technical documentation.

Atypical flight control response. A flight control dynamic response is considered atypical when it does not exhibit classic second order system behaviour.

Audited engineering simulation. An aeroplane manufacturer's engineering simulator which has undergone a review by the appropriate CAA and been found to be an acceptable source of supplemental validation data.

Automatic testing. FSTD testing wherein all stimuli are under computer control.

Background radio traffic. For the purposes of simulation, this refers to radiotelephony messages between air traffic control and other traffic that broadcast on the active frequency and heard by the flight crew.

Note 1.— The word "background" refers to the fact that these messages are not intended for the ownship. In real-world environments, other radio communications on the active frequency, such as aircraft-to-aircraft transmissions, may also be heard by the flight crew.

Note 2.— Background radio traffic is also known as "party line" or "background chatter".

Bank. Bank/roll angle (degrees).

Basic operating mass (BOM). The empty mass of the aeroplane plus the mass of the following: normal oil quantity; lavatory servicing fluid; potable water; required crew members and their baggage; and standard equipment.

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

Checking (pilot proficiency). The comparison of the knowledge about a task, or the skill or ability to perform a task, against an established set of criteria to determine that the knowledge, skill or ability observed meets or exceeds, or does not meet, those criteria.

Note.— The use of the words "testing" or "checking" depends on the CAA's preference, as they are very similar in meaning, and their use may be dependent on the outcome of the event, e.g. a step towards a licence issuance or a recurrent evaluation of competency.

Class of aeroplane. In relation to the classification of aeroplanes, means aeroplanes having similar operating characteristics.

Closed loop testing. A test method for which the flight control stimuli are generated by controllers which drive the FSTD to follow a pre-defined target response.

Computer controlled aeroplane (CCA). An aeroplane in which pilot inputs to the control surfaces are transferred and augmented via computers.

Control sweep. Movement of the appropriate pilot controller 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 initial position.

Convertible FSTD. An FSTD in which significant hardware or software, or a combination of both, are changed so that the device replicates a different model, type or variant, usually of the same aeroplane. The same FSTD platform, motion system, visual system, computers and necessary peripheral equipment can thus be used in more than one simulation.

Note.— The significance of the difference, as adjudged by the CAA, will dictate whether a complete separate QTG would be necessary. Otherwise, a supplemental section added to the original QTG may suffice.

Correct trend and magnitude (CT&M). 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. The engine parameter that is the most appropriate measure of propulsive force for that engine.

Damping.

a) *Critical damping.* 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.

b) *Overdamped.* 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.

c) *Underdamped.* 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. A visual system capable of meeting, as a minimum, the system brightness and contrast ratio requirements as identified in Appendix B.

Deadband. The amount of movement of the input for a system for which there is no reaction in the output or state of the system observed.

Device qualified as T only. Training on this FSTD type may be credited towards the issuance of the associated licence, rating or qualification.

Device qualified as TP**.** Training on this FSTD type may be credited towards the issuance of the associated licence, rating or qualification and should include all tasks to the level of proficiency required. Testing and checking can additionally be conducted provided that training-to-proficiency has also been completed on a device qualified to the same level.

Driven. A test method where the input stimulus or variable is driven or deposited by automatic means, generally a computer input.

Engineering simulator validation data. Validation data generated by an engineering simulation or engineering simulator that is acceptable to the CAA.

Evaluation (FSTD). The careful appraisal of an FSTD by the CAA to ascertain whether or not the criteria required for a specified qualification level are met.

Fidelity level. The level of realism assigned to each of the defined FSTD features.

Fidelity level — G. Where the fidelity level is G, the initial validation should be based on subjective evaluation against approved data, where available, complemented if necessary by approved subjective development, to determine a reference data standard. Recurrent validations should be measured objectively against the reference data standard.

Fidelity level — N. Where the fidelity level is N, the FSTD feature is not required.

Fidelity level — R. Where the fidelity level is R, the initial validation should be based on objective evaluation against approved data, complemented if necessary by approved subjective development, to determine a reference data standard. Recurrent validations should be objectively measured against the reference data standard.

Note.— Fidelity level R1 is defined in Chapter 2, 2.2.6.3.

Fidelity level — S. Where the fidelity level is S, the initial and recurrent validation should be based on objective evaluation against approved data.

Flight simulation training device (FSTD). A synthetic training device that is in compliance with the minimum requirements for FSTD qualification as described in this manual.

Flight test data. Actual aeroplane data obtained by the aeroplane manufacturer (or other approved supplier of data) during an aeroplane flight test programme.

Footprint test. A test conducted and recorded on the same FSTD, during its initial evaluation, to 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 CAA may require that the footprint test result be re-generated under the new conditions to form a new reference data standard.

Note.— See also definition of "master qualification test guide (MQTG)".

Free response. The hands-off response of the aeroplane after completion of a control input or disturbance.

Frozen/locked. A test condition where a variable is held constant over time.

FSTD approval. Declaration of the extent to which an FSTD of a specified qualification type may be used by an FSTD operator or training organization as agreed by the CAA. It takes account of differences between aeroplanes and FSTDs and of the operating and training ability of the organization.

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

FSTD feature. Describes the characteristics of an FSTD for each of the thirteen categories that have been used in this manual to define the general and technical requirements for FSTDs.

FSTD operator. The person, organization or enterprise directly responsible to the CAA for requesting and maintaining the qualification of a particular FSTD.

Note.— The term "FSTD operator" is similar to the term "sponsor" used in some national regulations.

FSTD qualification level. The level of technical capability of an FSTD.

FSTD user. The person, organization or enterprise requesting training, checking or testing credits through the use of an FSTD.

Full sweep. See definition for "control sweep".

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

Functions test. A quantitative and/or qualitative assessment of the operation and performance of an FSTD by a suitably qualified evaluator. The test should include verification of correct operation of controls, instruments and systems of the simulated aeroplane under normal and non-normal conditions.

Generic (G). The lowest level of required fidelity for a given FSTD feature.

Ground effect. A change in aerodynamic characteristics due to modification of the airflow pattern past the aeroplane, caused by proximity to the ground.

Ground reaction. Forces acting on the aeroplane due to contact with the ground. These forces include the effects of strut deflections, tire friction, side forces, structural contact and other appropriate aspects. These forces change appropriately, for example, with weight and speed.

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

Hands-on. A test manoeuvre conducted or completed with pilot control inputs.

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

Height. Height above ground = AGL (m or ft).

Highlight brightness. The maximum displayed brightness.

Icing accountability. Refers to changes from normal (as applicable to the individual aeroplane design) in take-off, climb (en-route, approach or landing) or landing operating procedures or performance data, in accordance with the Aeroplane Flight Manual, for flight in icing conditions or with ice accumulation on unprotected surfaces.

Integrated testing. Testing of the FSTD such that all aeroplane system models are active and contribute appropriately to the results.

Note 1.— None of the aeroplane system models should be substituted with models or other algorithms intended for testing purposes only.

Note 2.— This testing should be accomplished by using controller displacements as the input. These controllers should represent the displacement of the pilot's controls and should have been calibrated.

Intended use. Completion of the training and testing or checking tasks as prescribed in Part I of this document.

International Committee for FSTD Qualification (ICFQ). A former committee of the Royal Aeronautical Society that reviewed proposals for updating this manual. The reviews are now carried out by the International Pilot Training Consortium (IPTC) Training Device Work Stream (TDWS).

Irreversible control system. A control system in which movement of the control surface will not back drive the pilot's control on the flight deck.

Latency. Additional time, beyond that of the basic perceivable response time of the aeroplane, due to the response of the FSTD.

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

Light gross mass. A mass chosen by the FSTD operator or data provider that is not more than 120 per cent of the BOM of the aeroplane being simulated or as limited by the minimum practical operating mass of the test aeroplane.

Manual testing. FSTD testing wherein 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). The CAA-approved test guide that incorporates the results of tests acceptable to the authorities at the initial qualification. The MQTG, as amended, serves as the reference for future evaluations. It may have to be re-established if any approved changes occur to the device, but should still be compliant with the approved data.

Medium. Normal operating mass for the flight condition.

Medium gross mass. A mass chosen by the FSTD operator or data provider that is within ±10 per cent of the average of the numerical values of the BOM and the maximum certificated mass of the aeroplane being simulated.

Near maximum gross mass. A mass chosen by the FSTD operator or data provider that is not less than the BOM of the aeroplane being simulated plus 80 per cent of the difference between the maximum certificated mass (either take-off mass or landing mass, as appropriate for the test) and the BOM.

Night visual. A visual system capable of producing, as a minimum, all features applicable to the twilight scene (see "twilight (dusk/dawn) visual") with the exception of the need to portray reduced ambient intensity, therefore lacking ground cues that are not self-illuminating or illuminated by ownship lights (e.g. landing lights).

Nominal. Normal operating mass, configuration, speed, etc., for the flight segment specified.

None (N). Feature is not required.

Non-normal control. A state where one or more of the intended control, augmentation or protection functions are not fully available. Used in reference to computer-controlled aeroplanes.

Note.— Specific terms, such as alternate, direct, secondary or back-up, may be used to define an actual level of degradation used in reference to computer-controlled aeroplanes.

Normal control. A state where the intended control, augmentation and protection functions are fully available. Used in reference to computer-controlled aeroplanes.

Not applicable (N/A). A task not considered to be applicable to that part of the licence type or rating.

Objective test. A quantitative assessment based on comparison to data.

Other traffic. 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.

Passive force feedback. In the context of a Flight Controls System, passive force feedback indicates a passive system that may be provided by a spring or spring and damper arrangement and produces FSTD control forces that may or may not represent those of the aeroplane in any phase of flight in normal and, in particular, abnormal and emergency operations.

Protection functions. Systems functions designed to protect an aeroplane from exceeding its flight and manoeuvre limitations.

Pulse input. A step input to a control followed by an immediate return to the initial position.

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

Representative (R). The intermediate level of required fidelity for a given FSTD feature.

Reversible control system. A control system in which movement of the control surface will back drive the pilot's control on the flight deck.

Second segment. That portion of the take-off profile from after gear retraction to end of climb at V_2 and the beginning of the acceleration segment (initial flap/slat retraction).

Sideslip. Sideslip angle (degrees).

Simulated ATC environment. 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.

Snapshot. Presentation of one or more variables at a given instant in time.

Specific (S). The highest level of required fidelity for a given FSTD feature.

Stall. An aerodynamic loss of lift caused by exceeding the critical angle of attack.

Note.— A stalled condition may exist at any attitude and airspeed, and may be recognized by continuous stall warning activation accompanied by at least one of the following:

1) *buffeting, which may be heavy at times;*

2) *lack of pitch authority and/or roll control;*

3) *inability to arrest the rate of descent;*

Stall warning. A natural or synthetic indication provided when approaching a stall that may include one or more of the following indications:

a) aerodynamic buffeting (some aeroplanes will buffet more than others);

b) reduced roll stability and aileron effectiveness;

c) visual or aural cues and warnings;

d) reduced elevator (pitch) authority;

e) inability to maintain altitude or arrest rate of descent; and

f) stick shaker activation (if installed).

Note.— A stall warning indicates an immediate need to reduce the angle of attack.

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

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

Subjective test. A qualitative assessment based on established standards as interpreted by a suitably qualified person.

Testing (pilot proficiency). The comparison of the knowledge about a task, or the skill or ability to perform a task, against an established set of criteria to determine that the knowledge, skill or ability observed meets or exceeds, or does not meet, those criteria.

Note.— The use of the words "testing" or "checking" depends on the CAA's preference, as they are very similar in meaning, and their use may be dependent on the outcome of the event, e.g. a step towards a licence issuance or a recurrent evaluation of competency.

Throttle lever angle (TLA). The angle of the pilot's primary engine control lever(s) on the flight deck, which also may be referred to as TLA or power lever angle or throttle angle.

Time history. The presentation of the change of a variable with respect to time.

Train. The introduction of a specific training task. The training accomplished may be credited towards the issuance of a licence, rating or qualification, but the training would not be completed to proficiency. The fidelity level of one or more of the simulation features may not support training-to-proficiency.

Note.— In the context of this definition, the word "train" can be replaced by "training".

Train-to-proficiency. The introduction, continuation or completion of a specific training task. The training accomplished may be credited towards proficiency and/or the issuance of a licence, rating or qualification, and the training is completed to proficiency. The fidelity level of all simulation features supports training-to-proficiency.

Note.— In the context of this definition, the words "train-to-proficiency" can be replaced by "training-to-proficiency".

Transport delay. The FSTD system processing time required for an input signal from a pilot primary flight control until motion system, visual system and instrument response. It is a measure of the time from the flight control input through the hardware/software interface, through each of the host computer modules and back through the software/hardware interface to the motion system, flight instrument and visual system. Each of these three processing times excludes the aeroplane dynamic response and represents the transport delay for that particular system. It is the overall time delay incurred from signal input until output response and is independent of the characteristic delay of the aeroplane being simulated.

Twilight (dusk/dawn) visual. A visual system capable of producing, as a minimum, full-colour presentations of reduced ambient intensity and sufficient surfaces with appropriate textural cues that include self-illuminated objects such as road networks, ramp lighting and airport signage.

Update. The improvement or enhancement of an FSTD where it retains its existing qualification type.

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

Validation data. Data used to prove that the FSTD performance corresponds to that of the aeroplane.

Validation data roadmap (VDR). A document from the aeroplane validation data supplier 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.

Note.— The VDR is described in Attachment D.

Validation flight test data. 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 like FSTD parameters can be compared.

Validation test. A test by which FSTD parameters can be compared to the relevant validation data.

Visual ground segment. The visible distance on the ground, between the lower cut-off of the aeroplane cockpit and the furthest visible point, as limited by the prevailing visibility.

1.2 ABBREVIATIONS AND UNITS

The abbreviations and units used in Part II of this manual have the following meaning:

A/C	Aircraft
A_d	Total initial displacement of pilot controller (initial displacement to final resting amplitude)
A_n	Sequential amplitude of overshoot after initial X-axis crossing (e.g. A_1 = first overshoot)
ACARS	Aircraft Communication Addressing and Reporting System
ADS-B	Automatic Dependent Surveillance — Broadcast
ADS-C	Automatic Dependent Surveillance — Contract
ADS-R	Automatic Dependant Surveillance — Rebroadcast
AFM	Aeroplane Flight Manual
AGL	Above Ground Level (m or ft)
AOA	Angle of Attack (degrees)
AOC	Aeronautical Operational Communications
APCH	Approach
APU	Auxiliary Power Unit
APV	Approach Procedures with Vertical guidance
ASOS	Automated Surface Observation System
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATN	Aeronautical Telecommunication Network
ATO	Approved Training Organization
ATPL	Airline Transport Pilot Licence (Certificate or Type Rating)
ATS	Air Traffic Services
AWOS	Automated Weather Observation System
Baro	Barometric
BITE	Built-in Test Equipment
BOM	Basic Operating Mass
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAT I/II/III	Precision approach and landing operations category I/II/III
CCA	Computer-Controlled Aeroplane
CCD	Charge-Coupled Device
CDFA	Continuous Descent Final Approach
cd/m^2	Candela/metre^2 (3.4263 candela/m^2 = 1 ft-lambert)
CFIT	Controlled Flight Into Terrain
CFR	Code of Federal Regulations
cg	Centre of gravity
cm	Centimetre(s)
CPDLC	Controller Pilot Data Link Communications
CPL	Commercial Pilot Licence
CQ	Continuing Qualification
CR	Class Rating
ctd	continued
CT&M	Correct Trend and Magnitude

daN	DecaNewtons
D-ATIS	Data link ATIS
dB	Decibel
dBSPL	Decibel, Sound Pressure Level
DH	Decision Height
DLIC	Data Link Initiation Capability
DME	Distance Measuring Equipment
DOF	Degrees of Freedom
DSP	Data Service Provider
EASA	European Aviation Safety Agency
EFB	Electronic Flight Bag
EFIS	Electronic Flight Instrument System
EFVS	Enhanced Flight Vision System
EGPWS	Enhanced Ground Proximity Warning System
EPR	Engine Pressure Ratio
eQTG	Electronic Qualification Test Guide
ETOPS	Extended Operations

Note.— ETOPS, recently redefined as "extended diversion time operations", refers in this manual specifically to extended diversion time operations by aeroplanes with two turbine engines.

FAA	Federal Aviation Administration (United States of America)
FAF	Final Approach Fix
FANS	Future Air Navigation System
FAR	Federal Aviation Regulations
FCL	Flight Crew Licensing
FCOM	Flight Crew Operations Manual (or Operating Manual)
FMS	Flight Management System
FPCCM	Flight Planning and Cruise Control Manual
FPTD	Flight Procedures Training Device
FSTD	Flight Simulation Training Device
FOV	Field of View
ft	Foot (1 ft = 0.304801 m)
ft-lambert	Foot-lambert (1 ft-lambert = 3.4263 candela/m^2)
ft/min	Feet/minute (1 ft/min = 0.005 08 m/s)
G	Generic (as related to fidelity level)
g	Acceleration due to gravity (m/s^2 or ft/s^2; 1 g = 9.81 m/s^2 or 32.2 ft/s^2)
GBAS	Ground-Based Augmentation System
GLS	GBAS Landing System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
G/A	Go-Around
G/S	Glide Slope
HGS	Head-up Guidance System
HP	High Pass
HUD	Head-Up Display
Hz	Unit of frequency (1 Hz = one cycle per second)

IAF	Initial Approach Fix
IAS	Indicated Airspeed
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICFQ	International Committee for FSTD Qualification
ILS	Instrument Landing System
IO	Initial Operator training and checking
IOS	Instructor Operating Station
IPOM	Integrated Proof of Match
IPTC	International Pilot Training Consortium
IR	Initial Instrument Rating
ISD	Instructional System Design
IWG	International Working Group
JAA	European Joint Aviation Authorities
JAR	Joint Aviation Regulations
JAWS	Joint Airport Weather Studies
km	Kilometre(s) (1 km = 0.621 37 statute mile)
kPa	Kilopascal (kilonewton/m^2) (1 psi = 6.894 76 kPa)
kt	Knots calibrated airspeed unless otherwise specified (1 knot = 0.5144 m/s or 1.688 ft/s)
lb	Pound(s) (1 lb = 0.453 59 kg)
lbf	Pound-force (1 lbf = 4.448 2 newton)
LED	Light Emitting Diode
LNAV	Lateral Navigation
LOC-BC	ILS localizer Back Course
LOC	ILS localizer
LOFT	Line-Oriented Flight Training
LOS	Line-Operational Simulation
LP	Localizer Performance
LP	Low Pass
LPV	Localizer Performance with Vertical Guidance
m	Metre(s) (1 m = 3.280 84 ft)
MCQFSTD	Manual of Criteria for the Qualification of Flight Simulation Training Devices
MCTM	Maximum Certificated Take-off Mass (kilos/pounds)
MDA	Motion Drive Algorithm
min	Minute(s)
MLG	Main Landing Gear
MLS	Microwave Landing System
MPa	Megapascals (1 psi = 6 894.76 pascals)
MPL	Multi-crew Pilot Licence
MQTG	Master Qualification Test Guide
ms	Millisecond(s)
N	None (as related to fidelity level) or Normal control state referring to computer-controlled aeroplanes (depending on context)
n	Sequential period of a full cycle of oscillation
N_1	Low-pressure rotor revolutions per minute, expressed in per cent of maximum
N_2	High-pressure rotor revolutions per minute, expressed in per cent of maximum
N/A	Not Applicable

NDB	Non-Directional Beacon
NM	Nautical Mile (1 NM = 1 852 m = 6 076 ft)
NN	Non-Normal control state referring to computer-controlled aeroplanes
NWA	Nosewheel Angle (degrees)
Nx	Load factor in the aeroplane x-axis direction (see Attachment F, paragraph 8)
Ny	Load factor in the aeroplane y-axis direction
Nz	Load factor in the aeroplane z-axis direction (see Attachment F, paragraph 8)
OAT	Outside Air Temperature
OEM	Original Equipment Manufacturer
OMCT	Objective Motion Cueing Test
OTD	Other Training Device
P_0	Time from 90 per cent of the initial controller displacement until initial X-axis crossing (X-axis defined by the resting amplitude)
P_1	Period of first full cycle of oscillation after the initial X-axis crossing
P_2	Period of second full cycle of oscillation after the initial X-axis crossing
P_f	Impact or feel pressure
P_n	Sequential period of oscillation
PANS	Procedures for Air Navigation Services
PAPI	Precision Approach Path Indicator system
PAR	Precision Approach Radar
PBN	Performance-Based Navigation
pitch	Pitch angle (degrees)
PLA	Power Lever Angle
PLF	Power for Level Flight
POM	Proof of Match
PPL	Private Pilot Licence
PRM	Precision Runway Monitor
PSD	Power Spectral Density
psi	Pounds per square inch (1 psi = 6.894 76 kPa)
QFE	Altimeter setting related to a specific feature reference datum point (e.g. airport)
QNH	Altimeter setting related to Sea Level
QRH	Quick Reference Handbook
QTG	Qualification Test Guide
R	Representative (as related to fidelity level)
Rad	Radian
RAE	Royal Aerospace Establishment
RAeS	Royal Aeronautical Society
RAT	Ram Air Turbine
R/C	Rate of Climb (m/s or ft/min) (1 ft/min = 0.005 08 m/s)
R/D	Rate of Descent (m/s or ft/min)
Re	Recency (take-off and landing)
REIL	Runway End Identifier Lights
RL	Recurrent Licence Training and Checking
RMS	Root Mean Square
RNAV	Area Navigation
RNP	Required Navigation Performance
RO	Recurrent Operator Training and Checking
RPM	Revolutions per Minute

RTO	Rejected Take-Off
RVR	Runway Visual Range (m or ft)
S	Specific (as related to fidelity level)
s	Second(s)
SARPS	Standards and Recommended Practices
SBAS	Satellite-Based Augmentation System
sm	Statute Mile(s) (1 statute mile = 1 609 m = 5 280 ft)
SME	Subject Matter Expert
SMGCS	Surface Movement Guidance and Control System
SOC	Statement of Compliance
SPL	Sound Pressure Level
SSR	Secondary Surveillance Radar
T	Train(ing)
T_f	Total time of the flare manoeuvre duration
T_i	Total time from initial throttle movement until a 10 per cent response of a critical engine parameter
T_t	Total time from initial throttle movement to a 90 per cent increase or decrease in the power level specified
T(A)	Tolerance applied to amplitude
$T(A_d)$	Tolerance applied to residual amplitude
TACAN	Tactical Air Navigation
TAWS	Terrain Awareness Warning System
TBD	To Be Determined
TCAS	Traffic alert and Collision Avoidance System
TDWS	Training Device Work Stream
TGL	Temporary Guidance Leaflet
TIS-B	Traffic Information Service — Broadcast
TLA	Throttle (Thrust) Lever Angle
T/O	Take-Off
TP	Train(ing)-to-Proficiency
T(P)	Tolerance applied to period
TR	Type Rating Training and Checking
TRG	Training
UPRT	Upset prevention and recovery training
UTC	Coordinated Universal Time
V_1	Decision speed
V_2	Take-off safety speed
V_{eas}	Equivalent airspeed
V_{mca}	Minimum control speed (air)
V_{mcg}	Minimum control speed (ground)
V_{mcl}	Minimum control speed (landing)
V_{mo}	Maximum operating speed
V_{mu}	Minimum unstick speed
V_r	Rotate speed
V_s	Stall speed or minimum speed in the stall
V_{ss}	Stick shaker activation speed
VASIS	Visual Approach Slope Indicator System
VDR	Validation Data Roadmap
VFR	Visual Flight Rules

VGS	Visual Ground Segment
VHF	Very High Frequency
VOR	VHF Omnidirectional Radio Range
vs	Versus
WAT	Weight, Altitude, Temperature
2D	Two-dimensional
3D	Three-dimensional
°	Degree

____

Chapter 2

INTRODUCTION

Note.— In this part, all references to an appendix or an attachment point to content in Part II of this document unless otherwise indicated.

2.1 PURPOSE

2.1.1 Part II establishes the performance and documentation requirements for evaluation by CAAs of seven standard aeroplane FSTDs used for training and testing or checking of flight crew members. These requirements and methods of compliance were derived from the extensive experience of CAAs and industry.

2.1.2 Part II is intended to provide the means for a CAA to qualify an FSTD, subsequent to a request by an applicant, through initial and recurrent evaluations of the FSTD. Further, Part II is intended to provide the means for a CAA of other States to accept the qualifications granted by the State which conducted the initial and recurrent evaluations of an FSTD, without the need for additional evaluations, when considering approval of the use of that FSTD by applicants from their own State.

2.2 BACKGROUND

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

2.2.2 The FSTD requirements provided in this chapter are derived from training requirements which have been developed through a training task analysis, the details of which are fully presented in Part I. A summary of the FSTDs identified to support the training requirements is presented in the FSTD summary matrix (Table 2-1).

2.2.3 The MPL content is preliminary and offers a means by which the FSTD requirements may be satisfied but should not be treated as the only means by which the FSTD requirements of an MPL programme may be met. The relevant text in this manual will be updated when the pertinent information from the completion of the MPL programmes implementation phase becomes available.

2.2.4 The summary matrix defines the FSTD types by correlating training types against fidelity levels for key simulation features. Each of the FSTD types is designed to be used in the training and, if applicable, testing or checking towards the associated licences or ratings. The terminology used in the table below for training type, device feature and level of fidelity of device feature is defined as follows:

2.2.4.1 Training types:

MPL1	Multi-crew Pilot Licence — Phase 1, Core flying skills;
MPL2	Multi-crew Pilot Licence — Phase 2, Basic;
MPL3	Multi-crew Pilot Licence — Phase 3, Intermediate;
MPL4	Multi-crew Pilot Licence — Phase 4, Advanced;
IR	Initial Instrument Rating;
PPL	Private Pilot Licence;
CPL	Commercial Pilot Licence;
TR	Type Rating Training and Checking;
ATPL	Airline Transport Pilot Licence or Certificate;
CR	Class Rating;
RL	Recurrent Licence Training and Checking;
RO	Recurrent Operator Training and Checking;
IO	Initial Operator Training and Checking;
CQ	Continuing Qualification; and
Re	Recency (Take-off and Landing).

2.2.4.2 FSTD features:

Flight Deck Layout and Structure
Flight Model (Aerodynamics and Engine)
Ground Handling
Aeroplane Systems (ATA Chapters)
Flight Controls and Forces

Sound Cues
Visual Cues
Motion Cues

Environment — ATC
Environment — Navigation
Environment — Atmosphere and Weather
Environment — Aerodromes and Terrain

Miscellaneous (Instructor Operating Station, etc.)

2.2.4.3 Device feature fidelity level:

S (Specific)	—	Highest level of fidelity
R (Representative)	—	Intermediate level of fidelity
G (Generic)	—	Lowest level of fidelity
N (None)	—	Feature not required

For detailed definitions of fidelity levels S, R, G and N, see Chapter 1, Section 1.1.

2.2.5 Training codes:

2.2.5.1 Device qualified as T only. The introduction of a specific training task. The training accomplished may be credited towards the issuance of a licence, rating or qualification, but the training would not be completed to proficiency. The fidelity level of one or more of the simulation features may not support training-to-proficiency.

2.2.5.2 Device qualified as TP. The introduction, continuation or completion of a specific training task. The training accomplished may be credited towards proficiency and/or the issuance of a licence, rating or qualification, and the training is completed to proficiency. The fidelity level of all simulation features supports training-to-proficiency.

Table 2-1. FSTD Summary Matrix

Device Type	Licence or Type of Training	Train (T) or Train-to-Proficiency (TP)	Device Feature: 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
Type VII	MPL4 — Advanced	T + TP	S	S	S	S	S	R	S	R	S	S	R	R
	TR/ATPL	TP	S	S	S	S	S	R	S	R	S	S	R	R
	Re	T	S	S	S	S	S	R	S	R	N	S	R	R
	RL/RO/IO/CQ	TP	S	S	S	S	S	R	S	R	S	S	R	R
Type VI	MPL3 — Intermediate	T + TP	R	R	R	R	R	R	S	R1	S	S	R	R
Type V	TR/ATPL/RL/RO/IO	T	S	S	S	S	S	R	R	N	G	S	R	R
Type IV	MPL2 — Basic	T + TP	R	G	G	R	G	R	G	N	G	S	G	R
Type III	CR	T	R	R	R	R	R	G	R	N	N	S	G	G
Type II	IR	T	G	G	G	R	G	G	G	N	G	S	G	G
Type I	CPL	T	R	R	R	R	R	G	R	N	N	S	G	G(S)
	MPL1 — Core flying skills	T	R	R	R	R	R1	G	G	N	G	S	G	G
	PPL	T	R	R	R	R	R	G	R	N	N	S	G	R(S)

2.2.6 Notes for special cases in Table 2-1:

2.2.6.1 For Environment — ATC: All fidelity levels in the summary matrix above are shown greyed out as this feature is currently under development. Guidance on simulated ATC environment and related qualification criteria will remain subject to amendment based on experience (see Attachment O).

2.2.6.2 Type VI — MPL3 — Intermediate: MPL Phase 3 learning outcomes are not specific to aeroplane type. The Type VI FSTD example indicated in the summary matrix for MPL Phase 3 offers a means, but not the only means, by which the FSTD specifications support the training outcomes. The task analysis indicates the possibility to meet competency outcomes by a combination of training in the Type V and Type VII FSTD examples. The summary of the Type VI device example represents a class-like device specification, to meet the learning outcomes in Phase 3, with a representative high-performance multi-engine turbine aeroplane. Furthermore, the definition of this device type has not been confirmed by the ICAO MPL process. The relevant text in this manual may be updated when pertinent information from the completion of MPL programmes implementation becomes available, allowing this device type to be finally defined.

2.2.6.3 Type VI — MPL3 — Intermediate — Motion Cues — R1: The pilot receives an effective and representative motion cue and stimulus, which provides the appropriate sensations of acceleration of the aeroplane 6 degrees of freedom. Motion cues should always provide the correct sensation. 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.

2.2.6.4 Type I — CPL — Environment — Aerodromes and Terrain — G(S): Level S if required for specific VFR cross-country navigation training.

2.2.6.5 Type I — PPL — Environment — Aerodromes and Terrain — R(S): Level S if required for specific VFR cross-country navigation training.

2.2.6.6 Type I — MPL1 — Core flying skills — Flight Controls and Forces — R1: Aeroplane-like, derived from class, appropriate to aeroplane mass. Active force feedback not required.

2.2.6.7 The "Miscellaneous" category does not appear in the table.

2.2.7 The FSTD general and technical requirements defined in Appendix A are grouped by device feature. The FSTD validation tests and functions and subjective tests are found in Appendices B and C and are grouped by device type.

2.2.8 The preceding process resulted in the seven defined device types. The option still remains for an FSTD operator to define a unique device for specific training tasks. The process, utilizing Parts I and III, is similar to that used to attain the seven pre-defined device types. In very simple terms, one determines the training tasks, then selects the FSTD features and fidelity levels to support the tasks as described in Part I, Chapter 3 of this Volume. The associated qualification and validation testing requirements for those feature fidelity levels are obtained through Part III of this Volume. If considering using this process, the appropriate CAA should be consulted very early.

2.3 RELATED READING MATERIAL

2.3.1 Applicants seeking FSTD evaluation, qualification and approval for use of aeroplane FSTDs should consult references contained in related documents published by the International Civil Aviation Organization (ICAO), the International Air Transport Association (IATA) and the Royal Aeronautical Society (RAeS) referring to and/or dealing with the use of FSTDs and technical and operational requirements relevant to FSTD data and design. Applicable rules and regulations pertaining to the use of FSTDs in the State for which the FSTD qualification and approval is requested should also be consulted.

2.3.2 The related national and international documents which form the basis of the criteria set out in this document are:

ICAO	Annex 1 — *Personnel Licensing* Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes* Doc 4444 — *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM) Doc 9868 — *Procedures for Air Navigation Services — Training* (PANS-TRG) Doc 10011 — *Manual on Aeroplane Upset Prevention and Recovery Training*
Australia	Civil Aviation Safety Regulations (CASR) Part 60, *Synthetic Training Devices* Civil Aviation Order 45.0 FSD 1, *Operational Standards and Requirements, Approved Flight Simulators* FSD 2, *Operational Standards and Requirements, Approved Flight Training Devices*

Canada TP9685, *Aeroplane and Rotorcraft Simulator Manual*

France *Projet d'arrêté relatif à l'agrément des simulateurs de vol,* 1988

Europe EASA CS-FSTD (A) and (H)
JAR-FSTD A, *Aeroplane Flight Simulation Training Devices*
Part-FCL TGL #7, *Multi-crew Pilot Licence Training — Air Traffic Control Environment Simulation*

United Kingdom CAP 453, *Aeroplane Flight Simulators: Approval Requirements*

United States FAA 14 CFR Part 60, *Flight Simulation Training Device Initial and Continuing Qualification and Use*
Advisory Circular 120-40B, *Airplane Simulator Qualification*
Advisory Circular 120-45A, *Aeroplane Flight Training Device Qualification*
Advisory Circular 120-63, *Helicopter Simulator Qualification*
FAA-S-8081-5F, *Airline Transport Pilot and Type Rating Practical Test Standards for Aeroplanes*

2.3.3 Additional related documents are:

ARINC Report 433 — *Standard Measurements for Flight Simulation Quality*
Report 436 — *Guidelines for Electronic Qualification Test Guide*
Report 439 — *Guidance for Simulated Air Traffic Control Environments in Flight Simulation Training Devices*

IATA *Flight Simulation Training Device Design and Performance Data Requirements*
Simulated Air and Ground Traffic Environment for Flight Training

RAeS *Aeroplane Flight Simulator Evaluation Handbook*, Volume I
Aeroplane Flight Simulator Evaluation Handbook, Volume II

Industry-developed *Airplane Upset Recovery Training Aid*

2.3.4 It is important to regularly monitor regulatory guidance material on the CAA web sites to understand the latest regulatory opinion on new technology or practices.

2.4 FSTD QUALIFICATION

2.4.1 In dealing with FSTDs, CAAs differentiate between the technical criteria of the FSTD and its use for training/testing and checking. The FSTD should be evaluated by the CAA taking into consideration the aeroplane manufacturer's recommended training practices. Qualification is achieved by comparing the FSTD performance against the criteria specified in the Qualification Test Guide (QTG) for the qualification level sought.

2.4.2 The validation, functions and subjective tests required for the QTG enable the CAA to "spot check" the performance of the FSTD in order to confirm that it represents the aeroplane in some significant training and testing or checking areas. Without such spot checking using the QTG, FSTD performance cannot be verified in the time normally available for the regulatory evaluation. It should be clearly understood that the QTG does not provide for a rigorous examination of the quality of the simulation in all areas of flight and systems operation. The full testing of the FSTD is intended to have been completed by the FSTD manufacturer and its operator prior to the FSTD being submitted for the regulatory evaluation and prior to the delivery of the results in the QTG. This "in depth" testing is a fundamental part of the whole cycle of testing and is normally carried out using documented acceptance test procedures in which the test results are recorded. These procedures will test the functionality and performance of many areas of the simulation that are not addressed in the QTG as well as such items as the instructor operating station.

2.4.3 Once the FSTD has been qualified, the authority responsible for oversight of the activities of the user of the FSTD can approve what training tasks can be carried out. This determination should be based on the FSTD qualification, the availability of FSTDs, the experience of the FSTD user, the training programme in which the FSTD is to be used and the experience and qualifications of the pilots to be trained. This latter process results in the approved use of an FSTD within an approved training programme.

2.5 TESTING FOR FSTD QUALIFICATION

2.5.1 The FSTD should be assessed in those areas which are essential to completing the flight crew member training and testing or checking process. This includes the FSTD's longitudinal and lateral-directional responses; performance in take-off, climb, cruise, descent, approach and landing; all-weather operations; control checks; and pilot, flight engineer and instructor station functions checks. The motion, visual and sound systems should be evaluated to ensure their proper operation.

2.5.2 The intent is to evaluate the FSTD as objectively as possible. Pilot acceptance, however, is also an important consideration. Therefore, the FSTD should be subjected to the validation tests listed in Appendix B and the functions and subjective tests in Appendix C. Validation tests are used to objectively compare FSTD and aeroplane data to ensure that they agree within 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.

2.5.3 Tolerances listed for parameters in Appendix B should not be confused with FSTD design tolerances and are the maximum acceptable for FSTD qualification.

2.5.4 The validation testing for initial and recurrent evaluations listed in Appendix B should be conducted in accordance with the FSTD type against approved data. An optional process for recurrent evaluation using MQTG results as reference data is described in Attachment H.

2.5.4.1 Where the fidelity level is S, the initial and recurrent evaluations should be based on objective evaluation against approved data. For evaluation of FSTDs representing a specific aeroplane type, the aeroplane manufacturer's validation flight test data are preferred. Data from other sources may be used, subject to the review and concurrence of the CAA responsible for the qualification. The tolerances listed in Appendix B are applicable for the initial evaluation. Alternatively, the recurrent evaluation can be based on objective evaluation against MQTG results as described in Attachment H.

2.5.4.2 Where the fidelity level is R, the initial and recurrent validation will be based on objective evaluation against approved data for a class of aeroplane with the exception of aeroplane type specific FSTDs (Type V sound system and Type VII sound and motion systems) where these evaluations are against aeroplane type-specific data. For initial evaluation of FSTDs representing a class of aeroplane, the aeroplane manufacturer's validation flight test data are preferred. Data from other sources may be used, subject to the review and concurrence of the CAA responsible for the qualification.

2.5.4.2.1 For motion and sound systems, where approved subjective development is submitted for the initial evaluation, the QTG should contain both:

a) the original objective test results showing compliance to the validation flight test data; and

b) the “improved” results, based upon approved subjective development against the validation flight test data. If approved subjective development is used, the MQTG result for those particular cases will become the reference data standard. Recurrent validations should be objectively measured against the reference data standard.

2.5.4.2.2 The tolerances listed in Appendix B are applicable for both initial and recurrent evaluations except where approved subjective development is used for motion and sound systems.

2.5.4.2.3 Alternatively, the recurrent evaluation can be based on objective evaluation against MQTG results as described in Attachment H.

2.5.4.3 Where the fidelity level is G, the initial validation will be based on evaluation against approved 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 Appendix B are applicable for recurrent evaluations and should be applied to ensure the device remains at the standard initially qualified.

2.5.5 Requirements for generic or representative FSTD data are defined below.

2.5.5.1 Generic or representative data may be derived from a specific aeroplane within the class of aeroplanes the FSTD is representing or it may be based on information from several aeroplanes within the class. With the concurrence of the CAA, it may be in the form of a 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 CAA, it will become the validation data that will be used as reference for subsequent recurrent evaluations with the application of the stated tolerances.

2.5.5.2 The substantiation of the set of data used to build validation data should be in the form of a “Reference Data” engineering report and should show that the proposed validation data are representative of the aeroplane or the class of aeroplanes modelled. This report may include flight test data, manufacturer’s design data, information from the aeroplane flight manual (AFM) and maintenance manuals, results of approved or commonly accepted simulations or predictive models, recognized theoretical results, information from the public domain, or other sources as deemed necessary by the FSTD manufacturer to substantiate the proposed model.

2.5.6 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. However, the FSTD should be re-qualified following the release of the manufacturer’s data obtained during the type certification of the aeroplane. The re-qualification schedule should be as agreed by the CAA, the FSTD operator, the FSTD manufacturer and the aeroplane manufacturer. For additional information, see Attachment A.

2.5.7 FSTD operators 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 manual. In this instance it may be necessary for an FSTD operator to acquire additional flight test data.

2.5.8 During FSTD evaluation, if a problem is encountered with a particular validation test, the test may be repeated to ascertain if test equipment or personnel error caused the problem. Following this, if the test problem persists, an FSTD operator should be prepared to offer alternative test results which relate to the test in question.

2.5.9 Validation tests which do not meet the test criteria should be satisfactorily rectified or a rationale should be provided with appropriate engineering judgement.

2.6 QUALIFICATION TEST GUIDE (QTG)

2.6.1 The QTG is the primary reference document used for the evaluation of an FSTD. It contains FSTD test results, statements of compliance and other information to enable the evaluator to assess if the FSTD meets the test criteria described in this manual.

2.6.2 The applicant should submit a QTG which includes:

a) a title page including (as a minimum) the:

1) FSTD operator's name;

2) aeroplane model and series or class, as applicable, being simulated;

3) FSTD qualification level;

4) CAA FSTD identification number;

5) FSTD location;

6) FSTD manufacturer's unique identification or serial number; and

7) provision for dated signature blocks:

i) one for the FSTD operator to attest that the FSTD has been tested using a documented acceptance testing procedure covering flight deck layout, all simulated aeroplane systems and the Instructor Operating Station, as well as the engineering facilities, the motion, visual and other systems, as applicable;

ii) one for the FSTD operator to attest that all manual validation tests have been conducted in a satisfactory manner using only procedures as contained in the QTG manual test procedure;

iii) one for the FSTD operator to attest that the functions and subjective testing in accordance with Appendix C have been conducted in a satisfactory manner; and

iv) one for the FSTD operator and the CAA indicating overall acceptance of the QTG;

b) an FSTD information page providing (as a minimum):

1) applicable regulatory qualification standards;

2) the aeroplane model and series or class, as applicable, being simulated;

3) the aerodynamic data revision;

4) the engine model(s) and its(their) data revision(s);

5) the flight control data revision;

6) the avionic equipment system identification and revision level when the revision level affects the training and testing or checking capability of the FSTD;

7) the FSTD manufacturer;

8) the date of FSTD manufacture;

9) the FSTD computer identification;

10) the visual system type and manufacturer;

11) the motion system type and manufacturer;

12) three or more designated qualification visual scenes; and

13) supplemental information for additional areas of simulation which are not sufficiently important for the CAA to require a separate QTG;

c) a table of contents to include a list of all QTG tests including all sub-cases, unless provided elsewhere in the QTG;

d) a log of revisions and/or list of effective pages;

e) a listing of reference and source data for FSTD design and test;

f) a glossary of terms and symbols used;

g) a statement of compliance (SOC) with certain requirements; SOCs should refer to sources of information and show compliance rationale to explain how the referenced material is used, applicable mathematical equations and parameter values and conclusions reached (see the "Comments" column of Appendices A and B for SOC requirements);

h) recording procedures and required equipment for the validation tests;

i) the following items for each validation test designated in Appendix B:

1) *Test number*. The test number which follows the numbering system set out in Appendix B;

2) *Test title.* Short and definitive based on the test title referred to in Appendix B;

3) *Test objective*. A brief summary of what the test is intended to demonstrate;

4) *Demonstration procedure.* A brief description of how the objective is to be met. It 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;

5) *References.* References to the aeroplane data source documents including both the document number and the page/condition number and, if applicable, any data query references;

6) *Initial conditions.* A full and comprehensive list of the FSTD initial conditions;

7) *Test parameters.* A list of all parameters driven or constrained during the automatic test;

8) *Manual test procedures.* Procedures should be self-contained and sufficient to enable the test to be flown by a qualified pilot, by reference to flight deck instrumentation. 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;

9) *Automatic test procedures.* A test identification number for automatic tests should be provided;

10) *Evaluation criteria.* The main parameter(s) under scrutiny during the test;

11) *Expected result(s).* The aeroplane result, including tolerances and, if necessary, a further definition of the point at which the information was extracted from the source data;

12) *Test result*. FSTD validation test results obtained by the FSTD operator 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 CAA conducting the test;

   c) be time histories unless otherwise indicated and:

      i) should plot for each test the list of recommended parameters contained in the *Aeroplane Flight Simulator Evaluation Handbook*, Volume I (see 2.3.3);

      ii) be clearly marked with appropriate time reference points to ensure an accurate comparison between FSTD and aeroplane;

      iii) the FSTD result and validation data plotted should be clearly identified; and

      iv) in those cases where a “snapshot” result in lieu of a time history result is authorized, the FSTD operator 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 Appendix B;

13) *Validation data.*

   a) Computer-generated displays of flight test data overplotted with FSTD data should be provided. To ensure authenticity of the validation data, a copy of the original validation data, clearly marked with the document name, page number, the issuing organization and the test number and title as specified in 1) and 2) above, should also be provided;

b) 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; and

c) 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;

14) *Comparison of results.* The accepted means of comparing FSTD test results to the validation data is overplotting;

j) a copy of the applicable regulatory qualification standards, or appropriate sections as applicable, used in the initial evaluation; and

k) a copy of the validation data roadmap (VDR) to clearly identify (in matrix format only) sources of data for all required tests including sound and vibration data documents.

2.6.3 The QTG will provide the documented proof of compliance with the FSTD validation tests in Appendix B. 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 aeroplane data is essential to verify FSTD performance in each test. The evaluation serves to validate the FSTD test results given in the QTG.

2.7 MASTER QUALIFICATION TEST GUIDE (MQTG)

2.7.1 During the initial evaluation of an FSTD, the MQTG is created. This is the master document, as amended in agreement with the CAA, to which FSTD recurrent evaluation test results are compared.

2.7.2 After the initial evaluation, the MQTG is available as the document to use for recurrent or special evaluations and is also the document that any CAA can use as proof of an evaluation and current qualifications of an FSTD when approval for the use of the particular FSTD is requested for a specific training task.

2.8 ELECTRONIC QUALIFICATION TEST GUIDE (eQTG)

Use of an eQTG may reduce costs, save time and improve timely communication, and is becoming a common practice. ARINC Report 436 provides guidelines for an eQTG (see 2.3.3 above).

2.9 QUALITY MANAGEMENT SYSTEM AND CONFIGURATION MANAGEMENT

2.9.1 A quality management system which is acceptable to the CAA should be established and maintained by the FSTD operator to ensure the correct maintenance and performance of the FSTD. The quality management system may be based upon established industry standards, such as ARINC Report 433 (see 2.3.3 above).

2.9.2 A configuration management system should be established and maintained to ensure the continued integrity of the hardware and software as from the original qualification standard, or as amended or modified through the same system.

2.10 TYPES OF EVALUATIONS

2.10.1 An initial evaluation is the first evaluation of an FSTD to qualify it for use. It consists of a technical review of the QTG and a subsequent on-site validation of the FSTD to ensure it meets all the requirements of this manual.

2.10.2 Recurrent evaluations are those that may be accomplished periodically to ensure that the FSTD continues to meet its qualification level.

2.10.3 Special evaluations are those that may be accomplished resulting from any of the following circumstances:

a) a major hardware and/or software change which may affect the handling qualities, performance or systems representations of the FSTD;

b) a request for an upgrade for a higher qualification level;

c) the discovery of a situation that indicates the FSTD is not performing at its initial qualification standard;

d) re-location;

e) change of ownership; and

f) re-entry into service following a prolonged shut-down.

Note.— Some of the above circumstances may require establishing revised tests leading to an amendment of the MQTG.

2.11 CONDUCT OF EVALUATIONS

Note.— The Manual on the Approval of Training Organizations *(Doc 9841) contains guidance on the recognition by other States of an FSTD qualification issued by a State, including for the initial qualification of an FSTD that already holds a qualification issued by another State*.

2.11.1 Initial FSTD evaluations

2.11.1.1 An FSTD operator seeking qualification of an FSTD should make the request for an evaluation to the CAA of the State in which the FSTD will be located.

2.11.1.2 A copy of the FSTD's QTG, with annotated test results, should accompany the request. Any QTG deficiencies raised by the CAA should be corrected prior to the start of the evaluation.

2.11.1.3 The request for evaluation should also include a statement that the FSTD has been thoroughly tested using a documented acceptance testing procedure covering flight deck layout, all simulated aeroplane systems and the instructor operating station as well as the engineering facilities, motion, visual and other systems, as applicable. In addition, a statement should be provided that the FSTD meets the criteria described in this manual. The applicant should further certify that all the QTG tests for the requested qualification level have been satisfactorily conducted.

2.11.2 Modification of an FSTD

2.11.2.1 An **update** is a result of a change to the existing device where it retains its existing qualification level. The change may be approved through a recurrent evaluation or a special evaluation if deemed necessary by the CAA, according to the applicable regulations in effect at the time of initial qualification.

2.11.2.2 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 CAA, clearly mean an improvement to the performance and training capabilities of the device altogether, then the CAA may accept the proposed change as an update while allowing the device to retain its original qualification level.

2.11.2.3 An **upgrade** is defined as the raising of the qualification level of a device, which can only be achieved by undergoing a special qualification according to the latest applicable regulations.

2.11.2.4 In summary, as long as the qualification level of the device does not change, all changes made to the device should be considered to be updates pending approval by the CAA. An upgrade and consequent initial qualification according to latest regulations is only applicable when the FSTD operator requests a higher qualification level for the FSTD.

2.11.3 Temporary deactivation of a currently qualified FSTD

2.11.3.1 In the event an FSTD operator plans to remove an FSTD from active status for a prolonged period, the appropriate CAA should be notified and suitable controls established for the period the FSTD is inactive.

2.11.3.2 An understanding should be arranged with the CAA to ensure that the FSTD can be restored to active status at its originally qualified level.

2.11.4 Moving an FSTD to a new location

2.11.4.1 In instances where an FSTD is to be moved to a new location, the appropriate CAA should be advised of the planned activity and provided with a schedule of events related thereto.

2.11.4.2 Prior to returning the FSTD to service at the new location, the FSTD operator should agree with the appropriate CAA which of the validation and functional tests from the QTG should be performed to ensure that the FSTD performance meets its original qualification standard. A copy of the test documentation should be retained with the FSTD records for review by the appropriate CAA.

2.11.5 Composition of an evaluation team

2.11.5.1 For the purposes of qualification of an FSTD, an evaluation team is usually led by a pilot inspector from the CAA along with engineers and a type-qualified pilot.

2.11.5.2 The applicant should provide technical assistance in the operation of the FSTD and the required test equipment. The applicant should make available a suitably knowledgeable person to assist the evaluation team as required.

2.11.5.3 On an initial evaluation, the FSTD manufacturer and/or aeroplane manufacturer should have technical staff available to assist as required.

2.11.6 FSTD recurrent evaluations

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

2.11.6.2 The CAA having jurisdiction over the FSTD should establish the time interval between recurrent evaluations.

2.12 ADOPTION OF THIS MANUAL INTO THE REGULATORY FRAMEWORK

The articulation of Volume I of this manual and its amendments into the regulatory framework is the responsibility of the various CAAs through national regulatory documents such as FAA 14 CFR Part 60, EASA CS-FSTD (A) or other equivalent document (see 2.3.2).

2.13 FUTURE UPDATES OF THIS MANUAL

Appendix D describes the process to be used for proposed future updates to this manual.

2.14 EVALUATION HANDBOOKS

The *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 Royal Aeronautical Society (see 2.3.3).

2.15 GUIDANCE ON “GRANDFATHERED” RIGHTS

2.15.1 The regulatory standards for the qualification of FSTDs will continue to develop to cater for: changing training needs; data revisions; relocations; the introduction of new equipment, procedures and technologies; and mandated measures to address safety issues. The introduction of changes to the regulatory standards should not necessarily result in making existing qualified FSTDs obsolete. To enable accredited training to continue on them, "grandfathering" of the qualification should be applied. This allows continued training on the device provided it continues to meet the qualification standard achieved at its initial qualification.

2.15.2 When CAA’s implement these technical requirements into their regulations they should make provisions for the grandfathering of FSTDs that are in existence, on order, or under development. In addition, the regulations should include provisions to retroactively mandate certain updates that are considered important for aviation safety.

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Appendix A

FSTD REQUIREMENTS

INTRODUCTION

This appendix describes the minimum FSTD requirements for qualifying a device to an internationally agreed type, as defined in Chapter 2, Table 2-1. The validation tests and functions and subjective tests listed in Appendices B and C should also be consulted when determining the requirements for qualification. Certain requirements included in this appendix should be supported with a statement of compliance (SOC) and, in some designated cases, an objective test. The SOC should describe how the requirement was met, such as gear modelling approach, coefficient of friction sources, etc. In the following tabular listing of FSTD criteria, requirements for SOCs are indicated in the comments column.

1. REQUIREMENT — FLIGHT DECK LAYOUT AND STRUCTURE

1.	Feature General Requirement Flight Deck Layout and Structure	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.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.**					✓		✓	
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 approved 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 approved use.**		✓						

Feature Technical Requirement Flight Deck Layout and Structure		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.1	FLIGHT DECK STRUCTURE								
1.1.S.a	An enclosed, full scale replica of the flight deck of the aeroplane being simulated.							✓	
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 (ctd next two pages)	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. As applicable, equipment for operation of the flight deck windows should be included but the actual windows need not 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 and/or required bulkheads.*					✓		✓	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 not supported in the simulation software should be identified on the FSTD information page. Bulkheads containing only items such as landing gear pin storage compartments, fire axes or extinguishers, spare light bulbs, 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 CAA. Coordination should be concluded during the FSTD design phase.

Feature Technical Requirement Flight Deck Layout and Structure		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.1.S.c (ctd)									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 and/or instrument panels is acceptable provided: For Type V and Type VII: — 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; — instruments displayed are free of quantization (stepping); — 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; — 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.

Feature Technical Requirement Flight Deck Layout and Structure		**Type I**	**Type II**	**Type III**	**Type IV**	**Type V**	**Type VI**	**Type VII**	**Comments**
1.1.S.c (ctd)									For Type VII only: 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 aeroplanes. *Note 1.— The flight deck enclosure need only be representative of that in the aeroplane or those in the class of aeroplanes being simulated and should include windows.* *Note 2.— The enclosure need only extend to the aft end of the flight deck.*	✓*		✓	✓		✓		FSTD instruments and/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 quantization (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 flight deck, the physical dimensions of the enclosure may be acceptable to simulate more than one aeroplane or class of aeroplanes in a convertible FSTD. Each FSTD conversion should be representative of the aeroplane or class of aeroplanes being simulated which may require some controls, instruments, panels, masking, etc. to be changed for some conversions. * If the FSTD is used for VFR training, it should be a representation of the aeroplane or class of aeroplanes comparable to the actual aeroplane used for flight training.

Feature Technical Requirement Flight Deck Layout and Structure		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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; and associated controls, assembled in a spatial manner to resemble that of the aeroplane or class of aeroplanes being simulated. The flight instrument panel(s) position and crew member seats should provide the crew member(s) a representative posture at the controls and design eye position. *Note.— If the FSTD is used for any VFR training credit, it should be fitted with a representation of a glare shield that provides the crew member(s) with a representative design eye position comparable to that of the actual aeroplane used for training.*		✓						The assembled components should be compatible and function in a cohesive manner. FSTD instruments and/or instrument panels using electronically displayed 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 quantization (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 aeroplanes being simulated. If the FSTD is convertible, some may have to be changed for some conversions.*
1.2	SEATING								
1.2.1.S	Flight crew member seats should replicate those in the aeroplane being simulated.					✓		✓	
1.2.1.R	Flight crew member seats should represent 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 aeroplanes.		✓						

Feature Technical Requirement Flight Deck Layout and Structure		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.2.2.S.a	In addition to the flight crew member seats, there should be one instructor station seat and two suitable seats for an observer and an authority inspector. The location of at least one of these seats should provide an adequate view of the pilots' panels and forward windows.							✓	The authority may consider options to this requirement based on unique 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 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 two-hour training session.
1.2.2.S.b	In addition to the flight crew member seats, there should be one instructor station seat, and two suitable seats for an observer and an authority inspector.					✓			At least one seat should have a system to permit selective monitoring of all flight crew member and instructor communications.
1.2.2.R	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.	✓		✓	✓		✓		
1.2.2.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	FLIGHT DECK LIGHTING								
1.3.S	Flight deck lighting should replicate that in the aeroplane					✓		✓	
1.3.R	Lighting environment for panels and instruments should be sufficient for the operation being conducted	✓		✓	✓		✓		
1.3.G	Lighting environment for panels and instruments should be sufficient for the operation being conducted.		✓						

2. REQUIREMENT — FLIGHT MODEL (AERO AND ENGINE)

2.	Feature General Requirement Flight Model (Aero and Engine)	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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, centre of gravity location and configuration to support the approved 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, centre of gravity and moments of inertia as a function of payload and fuel loading should be implemented.**					✓		✓	
2.R	**Aerodynamic and engine 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.**	✓		✓			✓		
2.G	**Aerodynamic and engine modelling, aeroplane-like, 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.**		✓		✓				

Feature Technical Requirement Flight Model (Aero and Engine)		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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, centre of gravity location and configuration to support the approved use.					✓		✓	
2.1.S.b	Aerodynamic modelling, that includes, for aeroplanes issued an original type certificate after 30June 1980, 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 aeroplane manufacturer.					✓		✓	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.
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 Appendix B, section 3.3 and test 2.f (ground effect).
2.1.S.d	Aerodynamic modelling for the effects of reverse thrust on directional control.					✓		✓	Tests required. See Appendix B, tests 2.e.8 and 2.e.9 (directional control).
2.1.S.e (ctd next page)	Modelling that includes the effects of icing, where appropriate, on the airframe, aerodynamics and the engine(s). Icing models should simulate the aerodynamic degradation effects of ice accretion on the aeroplane lifting surfaces including 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 or aeroplane gross weight.					✓		✓	Icing effects simulation models are only required for aeroplanes authorized for operations in icing conditions. Icing simulation models should be developed to provide training in the specific skills required for recognition of ice accumulation and execution of the required response. Tests required. See Appendix B, test 2.i.1 (engine and airframe icing effects demonstration (aerodynamic stall)). Aeroplane OEM data or other acceptable analytical methods should be utilized to develop ice accretion models. Should data from other generic sources be used, this will not constitute specific data and as such does not qualify as specific simulation.

Feature Technical Requirement Flight Model (Aero and Engine)		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.1.S.e (ctd)									SOC required. The SOC should describe the effects which provide training in the specific skills required for recognition of icing phenomena and execution of recovery. The SOC should include verification that these effects have been tested. The SOC should describe the source data and any analytical methods used to develop ice accretion models. Coordination with the CAA is recommended well in advance of an FSTD evaluation and QTG submission.
2.1.S.f	Aerodynamic stall modelling that includes degradation in static/dynamic lateral-directional stability, degradation in control response (pitch, roll, yaw), uncommanded roll response or roll-off requiring significant control deflection to counter, apparent randomness or non-repeatability, changes in pitch stability, Mach effects and stall buffet, as appropriate to the aircraft type. The model should be capable of capturing the variations seen in stall characteristics of the aeroplane (e.g. the presence or absence of a pitch break).							✓	In view of the possible difficulties in obtaining data to support this feature, this aspect of the Specific criteria should be treated only as Representative (of that particular aeroplane type), unless flight test data is available. It should only be used when integrated with a Specific model of all pre-stall conditions and is therefore included in the S Category (see Attachment P, 1.1 for applicability). SOC required. The SOC should identify the sources of data used to develop the aerodynamics model. Of particular interest is a mapping of test points in the form of alpha/beta envelope plot for a minimum of flaps up and flaps down. For the flight test data, a list of the types of manoeuvres used to define the aerodynamics model for angle of attack ranges greater than the first indication of stall are to be provided per flap setting. The stall model should be evaluated by an SME pilot with knowledge of the cues necessary to accomplish the required training objectives and experience in conducting stalls in the type of aeroplane being simulated. The SME pilot conducting the stall model evaluation should be acceptable to the CAA and the aeroplane OEM. The SME pilot is also responsible for evaluating the other recognition cues (such as stall buffet, automation responses and control effectiveness).

Feature Technical Requirement Flight Model (Aero and Engine)		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.1.S.g	The aerodynamics model should incorporate an angle of attack and sideslip range to support the training task. At a minimum, the model should support an angle of attack range to 10° beyond the critical angle of attack. The critical angle of attack is the point where the behaviour of the aeroplane gives the pilot a clear and distinctive indication through the inherent flight characteristics (see definition of stall) or the characteristics resulting from the operation of a stall identification device (e.g. a stick pusher) that the aeroplane is stalled.							✓	The FSTD should be capable of performing upset recognition and recovery tasks as defined by and agreed with the FSTD operator's CAA and the aeroplane OEM (see Attachment P, 1.1 for applicability).
2.1.R	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, centre of gravity location, and configuration.	✓		✓			✓		
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, centre of gravity location and configuration.		✓		✓				
2.2	MASS PROPERTIES								
2.2.S	Type specific implementation of aeroplane mass properties, including mass, centre of gravity and moments of inertia as a function of payload and fuel loading. The effects of pitch attitude and of fuel slosh on the aeroplane centre of gravity 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 the effects of fuel slosh on centre of gravity.
2.2.R	N/A.								
2.2.G	N/A.								

3. REQUIREMENT — GROUND REACTION AND HANDLING CHARACTERISTICS

3.	Feature General Requirement Ground Reaction and Handling Characteristics	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
3.S	Represents ground reaction and handling characteristics of the aeroplane during surface operations to support the approved use. Brake and tire failure dynamics (including antiskid) 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.					✓		✓	
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 mass and geometry.		✓		✓				

Feature Technical Requirement Ground Reaction and Handling Characteristics		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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 include strut deflections, tire friction, side forces, environmental effects 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.
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, tire 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.
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 Appendix B, test 1.e (stopping). Subjective tests for (4), (5) and (6). See Appendix C.

Feature Technical Requirement Ground Reaction and Handling Characteristics		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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.	✓		✓			✓		
3.2.G	Stopping and directional control forces for dry runway conditions.		✓		✓				
3.3	BRAKE AND TIRE FAILURES								
3.3.S	Brake and tire 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.
3.3.R	N/A.								
3.3.G	N/A.								

4.	Feature General Requirement Aeroplane Systems (ATA Chapters)	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
4.S	**Aeroplane systems should be replicated with sufficient functionality for flight crew operation to support the approved 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 approved use.** **System functionality should enable sufficient normal and appropriate abnormal and emergency operating procedures to be accomplished.**	✓	✓	✓	✓		✓		
4.G	**N/A.**								

Feature Technical Requirement Aeroplane Systems (ATA Chapters)		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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 or original equipment manufacturer, or alternative approved 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 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 or original equipment manufacturer, or alternative approved 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.G	N/A.								
4.2	CIRCUIT BREAKERS								
4.2.S	Circuit breakers that affect procedures and/or result in observable flight deck indications should be functionally accurate.					✓		✓	
4.2.R	Circuit breakers that affect procedures and/or result in observable flight deck indications should be functionally accurate.	✓	✓	✓	✓		✓		Applicable if circuit breakers fitted.
4.2.G	N/A.								
4.3	INSTRUMENT INDICATIONS								
4.3.S	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.

Feature Technical Requirement Aeroplane Systems (ATA Chapters)		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
4.3.R	All relevant instrument indications involved in the class of aeroplanes being simulated 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.
4.3.G	N/A.								
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.					✓		✓	
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.	✓	✓	✓	✓		✓		
4.4.G	N/A.								
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 aeroplanes 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.
4.5.G	N/A.								

5. REQUIREMENT — FLIGHT CONTROLS AND FORCES

5.	Feature General Requirement Flight Controls and Forces	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.S	**Control forces and control travel should correspond to that of the aeroplane to support the approved 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.**					✓		✓	
5.R	**Aeroplane-like, derived from class, appropriate to aeroplane mass to support the approved use.** **Active force feedback required.**	✓ **PPL** **CPL**		✓			✓		
5.R1	**Aeroplane-like, derived from class, appropriate to aeroplane mass to support the approved use.** **Active force feedback not required.**	✓ **MPL1**							
5.G	**Aeroplane-like to support the approved use.** **Active force feedback not required.**		✓		✓				

Feature Technical Requirement Flight Controls and Forces		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.1	CONTROL FORCES AND TRAVEL								Testing of position versus force is not applicable if forces are generated solely by use of aeroplane hardware in the FSTD.
5.1.S.a	Control forces, control travel and surface position should correspond to that of the type-specific aeroplane being simulated. 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 aircraft equipped with a stick pusher system, control forces, displacement and surface position should correspond to that of the aeroplane being simulated. Control travel and forces should react in the same manner as in the aeroplane under the same flight and system conditions.							✓	SOC required. The SOC should verify that the stick pusher system/stall protection system has been modelled programmed, and validated using the aircraft manufacturer's design data or other approved data. The SOC should 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. See Appendix B, test 2.a.10 (stick pusher system force calibration).
5.1.R	Control forces, control travel and surface position should correspond to that of the aeroplane or class of aeroplanes being simulated. Control travel, forces and surfaces should react in the same manner as in the aeroplane or class of aeroplanes under the same flight and system conditions.	✓ PPL CPL		✓			✓		Active force feedback required if appropriate to the aeroplane installation.
5.1.R1	Control forces, control travel and surface position should correspond to that of the aeroplane or class of aeroplanes being simulated. Control surfaces should react in the same manner as in the aeroplane or class of aeroplanes under the same flight and system conditions, but control travel and forces should broadly correspond to the aeroplane or class of aeroplanes simulated.	✓ MPL1							Active force feedback not required.
5.1.G	Control forces, control travel and surface position should broadly correspond to the aeroplane or class of aeroplanes being simulated.		✓		✓				Active force feedback not required. Control forces produced by a passive arrangement are acceptable.

Feature Technical Requirement Flight Controls and Forces		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.2	CONTROL FEEL DYNAMICS								
5.2.S	Control feel dynamics should replicate the aeroplane being simulated.					✓		✓	See Appendix B, paragraph 3.2 for a discussion of acceptable methods of validating control dynamics. Tests required. See Appendix B, tests 2.b.1 through 2.b.3 (dynamic control checks).
5.2.R,G	N/A.								
5.3	CONTROL SYSTEM OPERATION								
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 Appendix C for applicable testing.
5.3. R, R1	Control systems should replicate the class of aeroplanes 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 Appendix C for applicable testing.
5.3.G	Control systems should allow basic aeroplane operation with appropriate cockpit indications.		✓		✓				See Appendix C for applicable testing.

6. REQUIREMENT — SOUND CUES

6.	**Feature General Requirement Sound Cues**	**Type I**	**Type II**	**Type III**	**Type IV**	**Type V**	**Type VI**	**Type VII**	**Comments**
6.S	**N/A.**								
6.R	**Significant sounds perceptible to the flight crew during flight operations to support the approved use.** **Comparable engine, airframe and environmental sounds.** **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 approved use.** **Comparable engine and airframe sounds.**	✓	✓	✓					

Feature Technical Requirement Sound Cues		**Type I**	**Type II**	**Type III**	**Type IV**	**Type V**	**Type VI**	**Type VII**	**Comments**
6.1	SOUND SYSTEM								
6.1.R	Significant 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.				✓	✓	✓	✓	SOC required. For Type VII: sounds associated with stall buffet should be replicated if significant in the aeroplane. Tests required. See Appendix B.
6.1.G	Significant flight deck sounds during normal and abnormal operations, aeroplane class-like, including engine and airframe sounds as well as those which result from pilot or instructor-induced actions.	✓	✓	✓					SOC required.
6.2	CRASH SOUNDS								
6.2.R	The sound of a crash when the aeroplane being simulated exceeds limitations.				✓	✓	✓	✓	
6.2.G	The sound of a crash when the aeroplane being simulated exceeds limitations.	✓	✓	✓					
6.3	ENVIRONMENTAL SOUNDS								
6.3.R	Significant environmental sounds should be coordinated with the simulated weather.				✓	✓	✓	✓	

Feature Technical Requirement Sound Cues		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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.R	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 approved dataset. 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 IOS page which is always visible to the instructor.
6.4.G	The volume control should have an indication of sound level setting which meets all qualification requirements. Full volume should correspond to actual volume level agreed at 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.R	Sound should be directionally representative.				✓	✓	✓	✓	SOC required.
6.5.G	Sound not required to be directional.	✓	✓	✓					

7. REQUIREMENT — VISUAL CUES

7.	Feature General Requirement Visual Cues	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
7.S	**Continuous field of view with infinity perspective and textured representation of all ambient conditions for each pilot, to support the approved use.** **Horizontal and vertical field of view to support the most demanding manoeuvres requiring a continuous view of the runway.** **A minimum of 200° horizontal and 40° vertical field of view.**						✔	✔	
7.R	**Continuous field of view with textured representation of all ambient conditions for each pilot, to support the approved use.** **Horizontal and vertical field of view to support the most demanding manoeuvres requiring a continuous view of the runway.** **A minimum of 200° horizontal and 40° vertical field of view.**	✔ **PPL** **CPL**		✔		✔			
7.G	**A textured representation of appropriate ambient conditions, to support the approved use.** **Horizontal and vertical field of view to support basic instrument flying and transition to visual from straight-in instrument approaches.**	✔ **MPL1**	✔		✔				

Feature Technical Requirement Visual Cues		**Type I**	**Type II**	**Type III**	**Type IV**	**Type V**	**Type VI**	**Type VII**	**Comments**
7.1	DISPLAY								
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° horizontal and 40° vertical field of view. The system should be free from optical discontinuities and artefacts that create non-realistic cues.						✓	✓	See Appendix B, test 4.a.1 (visual scene quality). An SOC is acceptable in place of this test. *Note.— Where the training task includes circling approaches with the landing on the reciprocal runway, a visual field of view in excess of 200° horizontal and 40° vertical would probably be required. Until such time as this becomes feasible the current arrangements in place with individual CAAs regarding approval for conducting specific circling approaches on a particular FSTD remain in place.*
7.1.1.R	Continuous visual field of view providing each pilot with 200° horizontal and 40° vertical field of view.	✓ PPL CPL		✓		✓			See Appendix B, test 4.a.1 (visual scene quality). Collimation is not required but parallax effects should be minimized (not greater than 10° 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. *Note.— Larger fields of view may be required for certain training tasks. The FOV should be agreed with the CAA.* 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° horizontally and 30° 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.	✓ MPL1	✓		✓				See Appendix B, test 4.a.1 (visual scene quality). Collimation is not required.

Feature Technical Requirement Visual Cues		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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 eyepoint.						✓	✓	SOC required containing calculations confirming resolution. See Appendix B, test 4.a.3 (surface resolution).
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 eyepoint.	✓ PPL CPL		✓		✓			SOC required containing calculations confirming resolution. See Appendix B, test 4.a.3 (surface resolution).
7.1.2.G	Adequate resolution to support the approved use.	✓ MPL1	✓		✓				
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 Appendix B, test 4.a.4 (light-point size).
7.1.3.R	Light-point size — not greater than 8 arc minutes.	✓ PPL CPL		✓		✓			SOC required confirming test pattern represents lights used for airport lighting. See Appendix B, test 4.a.4 (light-point size).
7.1.3.G	Suitable to support the approved use.	✓ MPL1	✓		✓				
7.1.4	DISPLAY CONTRAST RATIO								
7.1.4.S	Display contrast ratio — not less than 5:1.						✓	✓	See Appendix B, test 4.a.5 (raster surface contrast ratio).
7.1.4.R	Display contrast ratio — not less than 5:1.	✓ PPL CPL		✓		✓			See Appendix B, test 4.a.5 (raster surface contrast ratio).
7.1.4.G	Suitable to support the approved use.	✓ MPL1	✓		✓				
7.1.5	LIGHT-POINT CONTRAST RATIO								
7.1.5.S	Light-point contrast ratio — not less than 25:1.						✓	✓	See Appendix B, test 4.a.6 (light-point contrast ratio).
7.1.5.R	Light-point contrast ratio — not less than 10:1.	✓ PPL CPL		✓		✓			See Appendix B, test 4.a.6 (light-point contrast ratio).
7.1.5.G	Suitable to support the approved use.	✓ MPL1	✓		✓				

Feature Technical Requirement Visual Cues		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
7.1.6	LIGHT-POINT BRIGHTNESS								
7.1.6. S,R	Light-point brightness — not less than 20 cd/m^2 (5.8 ft-lamberts).	✓ PPL CPL		✓		✓	✓	✓	See Appendix B, test 4.a.7 (light-point brightness).
7.1.6.G	Suitable to support the approved use.	✓ MPL1	✓		✓				
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/m^2 (5.8 ft-lamberts).						✓	✓	See Appendix B, test 4.a.8 (surface brightness).
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/m^2 (4.1 ft-lamberts).	✓ PPL CPL		✓		✓			See Appendix B, test 4.a.8 (surface brightness).
7.1.7.G	Suitable to support the approved use.	✓ MPL1	✓		✓				
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 light valve projectors. An SOC should be provided if the test is not run, stating why. See Appendix B, test 4.a.9 (black level and sequential contrast).
7.1.8.R	Suitable to support the approved use.	✓ PPL CPL		✓		✓			
7.1.8.G	Suitable to support the approved use.	✓ MPL1	✓		✓				
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 pre-defined rate of movement across the image.						✓	✓	A test is generally only required for light valve projectors. An SOC should be provided if the test is not run, stating why. See Appendix B, test 4.a.10 (motion blur).
7.1.9.R	Suitable to support the approved use.	✓ PPL CPL		✓		✓			
7.1.9.G	Suitable to support the approved use.	✓ MPL1	✓		✓				

Feature Technical Requirement Visual Cues		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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 Appendix B, test 4.a.11 (speckle test).
7.1.10.R	Suitable to support the approved use.	✓ PPL CPL		✓		✓			
7.1.10.G	Suitable to support the approved use.	✓ MPL1	✓		✓				
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 each operation and phase of flight. An active display (repeater) of all parameters displayed on the pilot's combiner should be located on the instructor operating station (IOS), or other location approved by the CAA. Display format of the repeater should represent that of the combiner.						✓	✓	SOC required. See Appendix B, test 4.b (head-up display) and Attachment K.
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 instructor operating station (IOS), or other location approved by the CAA. Display format of the repeater should represent that of the combiner.	✓ PPL CPL		✓		✓			SOC required. See Appendix B, test 4.b (head-up display) and Attachment K. Only the one 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.								

Feature Technical Requirement Visual Cues		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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). Image should be repeated on the IOS as per HUD requirement in 7.2.1.S herein. IOS weather presets should be provided for EFVS minimums.						✓	✓	See Appendix B, test 4.c (enhanced flight vision system) and Attachment L.
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).	✓ PPL CPL		✓		✓			See Appendix B, test 4.c (enhanced flight vision system) and Attachment L. Only the one EFVS can be used by the pilot flying due to alignment display issues. Alternatively the EFVS may be presented as part of the visual scene.
7.2.2.G	N/A.								
7.3	VISUAL GROUND SEGMENT								
7.3.S	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 Appendix B, test 4.d (visual ground segment).
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.	✓ PPL CPL		✓		✓			See Appendix B, test 4.d (visual ground segment).
7.3.G	A demonstration of suitable visibility.	✓ MPL1	✓		✓				

8. REQUIREMENT — MOTION CUES

8.	Feature General Requirement Motion Cues	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
8.S	**N/A.**								
8.R	**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 the correct sensation to support the approved use.**							✓	
8.R1	**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 approved 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.**						✓		
8.G	**N/A.**								

Feature Technical Requirement Motion Cues		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
8.1	MOTION CUES GENERAL								When motion systems have been added by the FSTD operator 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.
8.1.R.a	Motion cues (vestibular) in 6 DOF, as perceived by the pilot, should be representative of the motion of the aeroplane being simulated (e.g. touchdown cues should be a function of the rate of descent (R/D) of the aeroplane being simulated).							✓	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 motion of the aeroplane being simulated for upset recovery and stall training tasks.							✓	Reproduction of the aeroplane's sustained load factor associated with these manoeuvres is not required. SOC required.
8.1.R1.a	Motion cues (vestibular) in 6 DOF, as perceived by the pilot, should be representative of the motion of the aeroplane being simulated (e.g. touchdown cues should be a function of the R/D of the aeroplane being simulated).						✓		SOC required.
8.1.R1.b	Motion cues (vestibular) in 6 DOF. The onset cues in the critical axes, as perceived by the pilot, should be representative of the motion of the aeroplane being simulated for upset recovery and stall training tasks.						✓		SOC required.
8.2	MOTION FORCE CUEING								
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).							✓	SOC required.
8.2.R1	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.

Feature Technical Requirement Motion Cues		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
8.3	MOTION EFFECTS								
8.3.R (ctd next page)	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 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 Appendix C.
	(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/speedbrake extension and thrust reversal.							✓	
	(4) Bumps associated with the landing gear.							✓	
	(5) Buffet during extension and retraction of landing gear.							✓	
	(6) Buffet in the air due to flap and spoiler/speedbrake extension.							✓	
	(7) Buffet due to atmospheric disturbances, e.g. turbulence in three linear axes (isotropic).							✓	
	(8) Approach to stall buffet.							✓	If there are known flight conditions where buffet is the first indication of stall, or where no stall buffet occurs, this 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) Tire failure dynamics.							✓	

Feature Technical Requirement Motion Cues		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
8.3.R (ctd)	(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.							✓	
8.3.R1	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 flight deck. Such effects should be in 3 axes, x, y and z, to represent the effects as experienced in the aeroplane:								See Appendix C.
8.3.R1 (ctd next page)	(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/speedbrake extension and thrust reversal.						✓		
	(4) Bumps associated with the landing gear.						✓		
	(5) Buffet during extension and retraction of landing gear.						✓		
	(6) Buffet in the air due to flap and spoiler/speedbrake extension.						✓		
	(7) Buffet due to atmospheric disturbances, e.g. turbulence in three linear axes (isotropic).						✓		
	(8) Approach to stall buffet.						✓		
	(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).						✓		

Feature Technical Requirement Motion Cues		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
8.3.R1 (ctd)	(11) Thrust effect with brakes set.						✓		
	(12) Mach and manoeuvre buffet.						✓		
	(13) Tire 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.R (ctd next page)	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 flight deck. The FSTD should be programmed and instrumented in such a manner that the characteristic vibration modes can be measured and compared to aeroplane data.								See Appendix B, test 3.f (characteristic motion vibrations). SOC required.
	(1) Thrust effects with brakes set.							✓	
	(2) Landing gear extended buffet.							✓	
	(3) Flaps extended buffet.							✓	
	(4) Speedbrake deployed buffet.							✓	

Feature Technical Requirement Motion Cues		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
8.4.R (ctd)	(5) Stall buffet amplitude and frequency content.							✓	Modelling increase in buffet amplitude from initial buffet threshold of perception to critical angle of attack or deterrent buffet as a function of angle of attack. The stall buffet modelling should include effects of Nz, as well as Nx and Ny if relevant. The frequency content of the stall buffet should be representative of stall buffets for the aeroplane being simulated. Tests required. See Appendix B, test 2.c.8a (stall characteristics) and test 3.f.5 (stall buffet). Instrument vibrations should be replicated, if significant in the aircraft. Note related sound requirements in 6.1.R.
	(6) High speed or Mach buffet.							✓	
	(7) In-flight vibrations.							✓	Propeller-driven aeroplanes only.
8.4.R1	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 flight deck. The FSTD should be programmed and instrumented in such a manner that the characteristic vibration modes can be measured.								See Appendix B, test 3.f (characteristic motion vibrations). SOC required.
	(1) Thrust effects with brakes set.						✓		
	(2) Landing gear extended buffet.						✓		
	(3) Flaps extended buffet.						✓		
	(4) Speedbrake deployed buffet.						✓		
	(5) Approach to stall buffet.						✓		
	(6) High speed or Mach buffet.						✓		
	(7) In-flight vibrations.						✓		Propeller-driven aeroplanes only.

9. REQUIREMENT — ENVIRONMENT — ATC

9.	Feature General Requirement Environment — ATC	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.	***Note.— Requirements for simulated ATC environment in this section should not be treated as prescriptive for FSTD qualification at this time. See Attachment O for guidance on the implementation of simulated ATC environment.***								
9.S	**Simulated ATC environment in the terminal area, representative of real-world airport locations and operations, with visual and audio correlated ground, landing and departing other traffic of scalable flow intensity to support the approved training programme.** **Airborne and ground other traffic follow appropriate routes for the airport location and exhibit representative performance and separation. Other traffic may be influenced by weather where this supports the training objectives.** **ATC communications are consistent with other traffic movements. Where training requires, ATC radio communications reflect location-specific procedures and nomenclature. Other traffic may also be visually correlated with cockpit instrument displays such as TCAS and ADS-B.** **Flight crew and ATC-initiated standard radio communications to the ownship are simulated, including data link communications where required by the training objectives. All simulated ATC communications are in English and should adhere to ICAO standard phraseology (as per Doc 4444, PANS-ATM).** **Automated ATC communications to the ownship are not expected during abnormal or emergency conditions, or for airspace regions beyond terminal areas, where the instructor may manually provide the ATC service.**						✓	✓*	**✓* — Not required for Re (T). Required for MPL4, TR/ATPL(TP), and RL/RO/IO/CQ(TP). This applies to all other Environment — ATC requirements for Type VII devices in this section.**

9.	Feature General Requirement Environment — ATC	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.G	Simulated ATC environment in the terminal area, representative of generic or real-world airport locations and operations, with visual (where available) and audio correlated ground, landing and departing other traffic of sufficient flow intensity to support the approved training programme. Airborne and ground other traffic follow appropriate routes and exhibit representative performance and separation. ATC communications are consistent with other traffic movements. Flight crew and ATC-initiated standard radio communications to the ownship are simulated. All simulated ATC communications are in English and should adhere to ICAO standard phraseology (as per Doc 4444, PANS-ATM). Automated ATC communications to the ownship are not expected during abnormal or emergency conditions, or for airspace regions beyond terminal areas, where the instructor may manually provide the ATC service.	✓ MPL1	✓		✓	✓			✓ MPL1 — Not required for CPL and PPL. Required for MPL1. This also applies to all other Environment — ATC requirements for Type I devices in this section.
9.N	Simulated ATC environment is not required.	✓ CPL PPL		✓				✓ Re (T)	

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.1	AUTOMATED WEATHER REPORTING								While automated terminal information service (ATIS) is the most common automated weather reporting system, other weather broadcast systems only need to be simulated where required by the training objectives.
9.1.1. S,G	Instructor control. The instructor has the ability to change the automated weather reporting message(s) from the IOS. The instructor should have the ability to override each value of any automated weather message.	✓ MPL1	✓		✓	✓	✓	✓*	
9.1.2.S	Automated weather reporting (multiple stations). In addition to the requirements detailed in 9.1.2.G below, the system should have the capability of generating more than one automated weather reporting message.						✓	✓*	Support for multiple station weather reporting broadcasts allows flight crews to listen simultaneously to concurrent automated weather reporting messages from different airports. The instructor may associate a particular automated weather reporting message to one or more airports, as necessary for the training session.
9.1.2.G	Automated weather reporting (single station). A single automated weather reporting message is required for all airports necessary for the training session. If the instructor makes a change to the message, it need not influence the weather conditions set in the FSTD. Conversely, the message need not change if the instructor changes the weather conditions set in the FSTD.	✓ MPL1	✓		✓	✓			The message should contain, at a minimum, the required elements of the weather reporting station type. This should include, but not be limited to, the following: airport, reference runway, temperature, wind, altimeter setting, clouds, visibility and runway conditions, as well as predefined other conditions (such as transition level). Different stations will contain airport-specific information within the message, but the elements of the message that relate to weather conditions will be uniform across all messages.
9.1.3.S	Message format and regional characteristics. Messages should conform to either standard ICAO specifications or regional formats where relevant to the training objectives.						✓	✓*	The format and content of automated weather reporting messages may vary depending on location. Differences may include message content order, units, languages, etc. The training provider should determine the level of fidelity required for regional characteristics where relevant to the training objectives.

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.1.3.G	ICAO message format. The format and content of automated weather reporting messages adhere to standard ICAO specifications (in accordance with Annex 11 — *Air Traffic Services*).	✓ MPL1	✓		✓	✓			
9.1.4.S	Provided by data link. Data link simulation may support text- and graphically-based weather services where required by the training objectives. Data link weather messages should correlate with the simulated environment. These messages may include: terminal weather information for pilots (TWIP), data link ATIS (D-ATIS), SIGMET, aerodrome routine meteorological report (METAR), notice to airmen (NOTAM), terminal aerodrome forecast (TAF) or others.						✓	✓*	D-ATIS is a text-based, digitally transmitted version of the ATIS audio broadcast. It is accessed via a data link service and can be displayed to the flight crew in the cockpit, commonly incorporated on the aircraft as part of a system such as an EFB or an FMS.
9.2	OTHER TRAFFIC Other traffic includes aeroplanes other than the ownship in the simulated environment, both airborne and on the ground. Other aeroplanes are part of the wider traffic context and may perform actions such as pushback, taxi, take-off and landing. Other traffic may also include ground vehicles where required to achieve specific training objectives.								Other traffic that can be seen and heard will help provide added realism to all flight phases, aid situational awareness and add to the cognitive workload of the flight crew. Emphasis should be on a configurable system that supports key training objectives, rather than representation of real-world operations.
9.2.1.S	Aircraft behaviour (airport-specific). In addition to the requirements detailed in 9.2.1.G below, ground aircraft movement and gate/stand allocation should be airport-specific.						✓	✓*	To enhance the airport scene for added realism, other aircraft should adhere to type-appropriate taxi routes, gates and parking stands. Specific airlines may be assigned to certain areas on the airport that generally reflect real-world operations.
9.2.1.G (ctd next page)	Aircraft behaviour. Airborne and ground aircraft follow appropriate routes and exhibit representative performance characteristics.	✓ MPL1	✓		✓	✓			At a minimum, landing and departing aircraft should use major taxiway routes. This traffic should be fully automated and also largely non-intrusive in order to minimize the need for instructor management. Traffic should exhibit representative type performance characteristics in order not to demonstrate obviously erroneous behaviours.

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.2.1.G (ctd)									Ground traffic should, in general, adhere to standard rules and procedures in order not to create a distraction for the flight crew. At a minimum, ground traffic should follow typical speed restrictions and runway holding point procedures.
9.2.2.S	Airport clutter. Airport ground clutter does not need to have an active radio presence, unless this includes other traffic undertaking ground manoeuvres that would typically necessitate communication with ATC. Simulated ATC environment should control other traffic with an ATC radio presence.						✓	✓*	Airport clutter is pre-scripted ground traffic added only for realism in order to create a sense of movement in the airport scene. It will often perform repeated actions, and typically includes baggage carts, ground personnel and service vehicles. Clutter may also include other stationary aircraft or other aircraft undertaking ground movements. This traffic generally moves in areas where the ownship is not expected and as such should be non-intrusive.
9.2.3.S	Traffic flow and separation (scalable). In addition to the requirements detailed in 9.2.3.G below, the intensity of other traffic in the simulated environment should be scalable by the instructor during a training session where required by the training objectives.						✓	✓*	Several distinct traffic intensity levels, such as low/medium/high, should be provided along with instructor control during the training session. As a practical guide, appropriate traffic intensity levels for the reference runway may fall within the following three levels (these figures are a guide and should not be considered a requirement for training approval or device qualification): — Low: Approximately 10 other traffic movements per hour (local-, regional-, low-capacity needs airport). — Medium: Approximately 15 other traffic movements per hour (regional-, medium-capacity needs airport). — High: Approximately 30 other traffic movements per hour (major-, high-capacity needs airport). Other traffic, in addition to that using the reference runway, may be added to enhance the airport scene and create a busy traffic environment, where this supports the training objectives.

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.2.3.G	Traffic flow and separation. Traffic flow should be of sufficient intensity to accomplish the training objectives. Other traffic separation times/distances and minimum wake vortex separation criteria should be representative of the real world.	✓ MPL1	✓		✓	✓			
9.2.4.S	Traffic type (airport specific). Other aircraft types should be representative of operations at the airport location.						✓	✓*	
9.2.5. S,G	Traffic call sign and livery. Other aircraft call signs and livery should be representative of their operator.	✓ MPL1	✓		✓	✓	✓	✓*	Other aircraft should have allocated call signs and livery representative of their operator so that audio and visual cues to the flight crew are correlated.
9.2.6.S	Runway incursion. Where training requires, the instructor has the ability to trigger runway incursion threats.						✓	✓*	In order to achieve a particular training objective (e.g. rejected take-off or go-around training), the instructor has the ability to cause other aeroplanes or vehicles to create a conflict with the ownship on the runway.
9.2.7.S	Ownship priority. In addition to the requirements detailed in 9.2.7.G below, the instructor should also have the capability to give precedence to and/or promote the ownship with respect to other traffic.						✓	✓*	Precedence for the ownship during ground manoeuvres or while airborne will enable the instructor to force behaviour or removal from the scenario of other traffic in order to facilitate expedited passage of the ownship. Promotion of the ownship will enable the instructor to reposition the ownship at any location within a queue on the ground or traffic pattern in the airspace environment. These features concern training efficiency and are intended to save non-productive FSTD time, rather than enhance realism. As such, they should not be considered a requirement for training approval or device qualification.
9.2.7.G	Ownship priority (other traffic removal). The instructor should have the capability to remove any other traffic impeding the flow of the training scenario.	✓ MPL	✓		✓	✓			This feature concerns training efficiency and is intended to save non-productive FSTD time, rather than enhance realism. As such, it should not be considered a requirement for training approval or device qualification.

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.3	BACKGROUND RADIO TRAFFIC								Background radio traffic (also known as party line or background chatter) concerns communications not addressed to the ownship heard on the flight deck. The simulation of radio communications other than those involving ATC is not required. Where beneficial for specific training purposes, non-ATC communications (such as operations, company, or aeroplane-to-aeroplane) may be delivered by other means. Realistic contextual background radio traffic will help to enhance the flight crew's situational awareness of their position in relation to other traffic (both airborne and on the ground). Simulated radio traffic should not be unintentionally distracting to the flight crew where it could negatively impact training.
9.3.1. S,G	Background radio traffic. In general all background radio traffic should meet the following criteria: (1) communications should make sense within the context of the simulation environment and should not contain obviously erroneous information; (2) only messages relevant to the purpose of a given frequency should be heard on that frequency; (3) simulated communications on a given frequency should not normally step over one another or over those from the flight crew; and (4) reasonable pauses should be provided between communication exchanges to allow the flight crew access to the frequency.	✓ MPL1	✓		✓	✓	✓	✓*	

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.3.2.S	Other traffic radio communications (intrusive). In addition to the requirements detailed in 9.3.2.G below, intrusive background radio traffic should also be available where required by the training objectives.						✓	✓*	Other traffic radio communications can be considered "intrusive" if the transmission pertains to some aspect of the training evolution; that is, if the flight crew has to give consideration either to a radio transmission or behaviour exhibited by another aeroplane because it may affect the ownship, it can be considered "intrusive". Intrusive other traffic is likely to be in close proximity to the ownship at times, and communications should be correlated with both out-the-window and on-board aircraft displays for all flight phases.
9.3.2.G	Other traffic radio communications (non-intrusive). Non-intrusive background radio traffic should be available. The intensity of radio traffic communications should be generally consistent with the traffic intensity.	✓ MPL1	✓		✓	✓			Non-intrusive radio traffic can be considered extraneous communication that is included only to improve the realism of the training experience. Non-intrusive other traffic is unlikely to be seen by the flight crew, particularly while airborne, either out the window or via on-board aircraft displays. However, if it were to become visible to the flight crew in the real-world environment, it should be presented in the FSTD (that is, correlated with visual and on board display systems). Non-intrusive background radio traffic is intended to be a higher fidelity replacement to traditional "background chatter" in FSTDs.
9.3.3.S	ATC radio communications (location specific). In addition to the requirements detailed in 9.3.3.G below, location-specific ATC procedures and nomenclature should be accurately reflected in communications where training requires.						✓	✓*	

Feature Technical Requirement Environment — ATC		**Type I**	**Type II**	**Type III**	**Type IV**	**Type V**	**Type VI**	**Type VII**	**Comments**
9.3.3.G	ATC radio communications. ATC and other traffic-initiated communications are consistent with other traffic movements, continuous across sector boundaries, and comply, where possible, with ICAO standard phraseology (as per Doc 4444, PANS-ATM).	✓ MPL1	✓		✓	✓			The system should support both ATC and other traffic-initiated standard ATC radio communications. Communications should maintain continuity across ATC sector boundaries. Transmissions should comply, where possible, with the ATC radio communication phraseologies detailed in Doc 4444, PANS-ATM, Chapter 12, under the following categories (where appropriate to the training): i. General ii. Area control services iii. Approach control services iv. Vicinity of the aerodrome v. Phraseologies for use on or in the ATS surveillance service vi. Radar in approach control service vii. Secondary surveillance radar (SSR) and automatic dependent surveillance-broadcast (ADS-B) phraseologies viii. General automatic dependent surveillance-contract (ADS-C) phraseologies.
9.3.4. S,G	Overstepping on frequency. Flight crew overstepping on other traffic radio transmissions should cause a basic ATC notification. The instructor should have an indication of the overstepping event at the IOS.	✓ MPL1	✓		✓	✓	✓	✓*	In real-world operations, overstepping can occur when more than one transmitter transmits concurrently on the same radio frequency. The experience of the flight crew and any ATC resolution of this situation may vary depending on a number of factors. In order to best support the flow of training, re-broadcast of other traffic and ATC radio transmissions that have been overstepped by the flight crew is not required. The scope of this feature is not required to extend to other traffic or ATC overstepping on flight crew transmissions, or simulating ATC resolution of a prolonged blocking of the control frequency by the flight crew.

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.4	AIRPORT AND AIRSPACE MODELLING								The fidelity, detail and scope of the modelled airport and terminal area airspace need only to be adequate enough to meet the training objectives. It is recommended that the scope of airport/airspace modelling (for either a generic or specific modelled area) is best determined by the training provider.
9.4.1.S	Simulated ATC environment modelled areas (specific). The system should include a minimum of one specific airport model with associated terminal area and two additional generic or higher fidelity airports with associated terminal areas that are part of the approved training programme.						✓	✓*	It is necessary for simulated ATC environment to be implemented at multiple airport locations in order to facilitate LOFT type training scenarios. Non-real-world generic airport and airspace models should broadly reflect ICAO standards for aerodrome and airspace design (as outlined in Doc 8168, PANS-OPS and Doc 4444, PANS-ATM).
9.4.1.G	Simulated ATC environment modelled areas (generic). The system should include a minimum of two generic real-world or non-real-world airport models with associated terminal areas that are part of the approved training programme.	✓ MPL1	✓		✓	✓			Non-real-world generic airport and airspace models should broadly reflect ICAO standards for aerodrome and airspace design (as outlined in Doc 8168, PANS-OPS and Doc 4444, PANS-ATM).
9.4.2.S	Runways (multiple). In addition to the requirements detailed in 9.4.2.G below, other traffic movements on more than one runway are supported, where training requires, and the real-world airport has multiple runways.						✓	✓*	Although desirable to enhance the airport scene and for specific training scenarios (for example, runway incursion training), other traffic need not use more than one runway at the same time. Where specific airports are simulated, real-world operational limitations are reflected in the background traffic patterns.
9.4.2.G	Runways (single). Other traffic movements on a single runway in both directions are supported.	✓ MPL1	✓		✓	✓			Other traffic movements may include the following modes: take-off only, landing only, or both take-off and landing on the reference runway in either direction at a given time.
9.4.3. S,G	Data synchronization. Other traffic behaviours and radio communications are consistent with the airport model and airspace data used by the FSTD.	✓ MPL1	✓		✓	✓	✓	✓*	

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.5	WEATHER								
9.5.1. S,G	Reference runway. Other traffic behaviour should be determined by and consistent with the reference runway.	✓ MPL1	✓		✓	✓	✓	✓*	Other traffic behaviour, such as the direction of take-off and landing and the departure and arrival routing, should be determined by and consistent with the reference runway selected in the FSTD.
9.5.2.S	Other traffic separation. Other traffic separation is representative of real-world operations and correlates with the weather set at the airport location.						✓	✓*	
9.5.3.S	Low visibility operations. Where low visibility operations training is required, other traffic movements should respect low visibility procedures at the airport location.						✓	✓*	This functionality is only required at modelled airports that support low visibility training.
9.6	ATC — OWNSHIP COMMUNICATIONS								The method of delivery of simulated ATC communications to the ownship is not prescribed. It should be noted that a fully automated synthetic ATC service is not mandated. Where automated methods are used to simulate the majority of communications, it is not expected that all communications be automated.
9.6.1. S,G	Time synchronization. ATC communications (including automated weather reporting) that involve a reference to time should be correlated with the time displayed in the FSTD.	✓ MPL1	✓		✓	✓	✓	✓*	The system should have the capability of aligning ATC communications and weather reporting messages with the simulated time in the FSTD.
9.6.2. S,G	ATC radio communications. The system supports standard communications to and from the ownship. Communications should maintain continuity across ATC sector boundaries. Transmissions should comply with the phraseologies detailed in Doc 4444, PANS-ATM (Chapter 12). Where the ownship is transitioning between terminal areas, a continual ATC service is required at a level adequate to meet the training objectives. It is not expected that ATC communications to the ownship will be automatically simulated during abnormal and emergency conditions or for airspace regions beyond terminal areas.	✓ MPL1	✓		✓	✓	✓	✓*	The system should support both ATC and flight crew initiated standard ATC radio communications to and from the ownship. The ATC service to the ownship may be provided manually by the instructor; however, this method is not recommended for all communications, as it distracts the instructor from the primary task of observation.

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.6.3.S	Message triggering (automatic). Messages to the ownship can be automatically triggered during a training session.						✓	✓*	ATC messages to the ownship may be generated by a number of methods, such as from the lesson plan or by an instructor action at the IOS. This feature may require an override and/or mute function so the instructor has control over automated messages and/or can revert back to manual delivery of ATC communications.
9.6.3.G	Message triggering (manual). The instructor should be able to manually trigger ATC messages to the ownship during a training session. Transmissions to the ownship should occur using the same ATC voices used to simulate background radio communications.	✓ MPL1	✓		✓	✓			Of paramount importance is that the workload of the instructor should be kept to a minimum. As such, automation and user interface enhancements that can help to minimize the instructor's workload in this area are highly desirable.
9.6.4. S,G	"Standby" and "say again." Basic standby responses and requests for repeated information from ATC and the flight crew are supported.	✓ MPL1	✓		✓	✓	✓	✓*	
9.6.5. S,G	Readback and acknowledgements. Basic readback and acknowledgement errors from the flight crew should be corrected by ATC.	✓ MPL1	✓		✓	✓	✓	✓*	
9.6.6.S	Clearance deviations. Where training requires, ownship deviations from clearances or instructions should generate a response from ATC to the flight crew. The system should allow the instructor the option to intervene manually in such an event.						✓	✓*	Ownship deviations may include not respecting assigned speed, heading or altitude when airborne, or deviating from a cleared routing when on the ground.
9.7	LANGUAGE AND PHRASEOLOGY								
9.7.1. S,G	English. All communications are conducted as per Doc 4444, PANS-ATM.	✓ MPL1	✓		✓	✓	✓	✓*	
9.7.2. S,G	Standard phraseology. All simulated ATC radio transmissions to the ownship and between ATC and other traffic should, where possible, adhere to ICAO standard phraseology (as per Doc 4444, PANS-ATM).	✓ MPL1	✓		✓	✓	✓	✓*	It is of utmost importance that simulated ATC radio communications reinforce the correct use of standard phraseology. Adherence to ICAO standard phraseology may not always be achieved where the instructor manually provides the ATC service to the ownship.

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.8	OWNSHIP RADIO OPERATION								
9.8.1. S,G	Multi-frequency radio operation. Each pilot has the ability to select and listen to at least one radio frequency. The system supports multiple radios being operated concurrently.	✓ MPL1	✓		✓	✓	✓	✓*	Example: The pilot flying may listen to ATIS on VHF 1 while the pilot monitoring waits for clearance delivery on VHF 2.
9.9	SYSTEM CORRELATION								
9.9.1. S,G	Visual system. Where a visual display system is present, it should present other traffic correlated with simulated ATC environment.	✓ MPL1	✓		✓	✓	✓	✓*	Where an FSTD offers a visual display system, the flight crew should expect to see other traffic movements correlated with the simulated ATC environment. Visual correlation is required in order to maintain continuity between visual and audio cues for the flight crew.
9.9.2.S	TCAS. Where training requires, other traffic should become visible on the TCAS display and be able to trigger appropriate warnings when in close proximity to the ownship. Other traffic is not required to take evasive action or follow correct TCAS protocols.						✓	✓*	Short-term pre-scripted TCAS training scenarios are not required as part of the simulated ATC environment. Other traffic is not required to take evasive action or follow correct TCAS protocols in the case where ownship manoeuvres have triggered a TCAS advisory.
9.9.3.S	Cockpit traffic displays. Where training requires, and where the ownship is equipped, other traffic becomes visible on cockpit displays such as ADS-B, ADS-R and TIS-B. Other traffic is not expected to exhibit self-managing behaviours other than basic navigation along pre-defined routes.						✓	✓*	If the training requires other traffic to be represented, cockpit display systems should be correlated with the FSTD visual display, radio communications and on the IOS. As with TCAS, the primary training benefit of this will be that the ownship flight crew is able to identify and manage threats from surrounding traffic.
9.9.4. S,G	IOS. The instructor should have access to basic information regarding other traffic and visibility of the wider traffic context.	✓ MPL1	✓		✓	✓	✓	✓*	The instructor should have access to basic information regarding other traffic on the IOS, as necessary to support training, such as call sign, aircraft type and basic flight plan details. The IOS should also include a situational display showing ownship and other traffic.
9.10	DATA LINK COMMUNICATIONS The simulation of data link communications is only required where necessary to support training objectives. Use of data link communications is not anticipated for MPL 1, 2 or 3. MPL 4 training objectives may require implementation of some data link features.								Data link communications that are unrelated to ATC (such as company communications and e-mail services) may be simulated where deemed beneficial for training, but are not required. If data link is used to replace voice communication, the fidelity of ATC data communications should match that of voice communications.

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.10.1.S	ATS clearances. ATS clearance messages are supported and should be consistent with published routes, waypoints, flight information regions and real-world ATC centres. Clearances should be consistent with clearances available from corresponding real-world ATC service providers.						✓	✓*	
9.10.2.S	ATS weather messages. ATS weather messages are supported and should be correlated with simulated weather conditions. Text reports should be consistent with information available via other automated weather reporting services and, if appropriate, correspond to visual cues and weather instrument displays.						✓	✓*	
9.10.3.S	Data Link Initiation Capability (DLIC). DLIC is supported and allows the flight crew to establish a connection with a controller pilot data link communications (CPDLC) service provider that corresponds to a real-world air traffic service unit. The four character ICAO identifier of the unit (see Doc 7910 — *Location indicators*) for CPDLC should correspond to its respective simulated region as described by the ICAO *Global Operational Data Link Document* (GOLD) or any other current, published standard.						✓	✓*	
9.10.4.S	Connection management. The system supports transferring and terminating data link connections, including CPDLC and ADS-C. The system should simulate the transfer between an active data service provider and the next data service provider at the appropriate time and/or distance from a control boundary. The system should support termination of a data link connection by the flight crew or simulated ATC service provider.						✓	✓*	

Feature Technical Requirement Environment — ATC		**Type I**	**Type II**	**Type III**	**Type IV**	**Type V**	**Type VI**	**Type VII**	**Comments**
9.10.5.S	CPDLC. The system supports a CPDLC message set sufficient to deliver the training objectives. The flight crew is able to send, receive and display CPDLC messages supported by the hardware platform. CPDLC messaging should be consistent with regional protocols, using the message set available for the corresponding active data authority. Messages should result in correct cockpit visual and/or audio indications.						✓	✓*	
9.10.6.S	ADS-C. The system supports the provision of all ADS-C messages sufficient to deliver the training objectives. The ADS-C simulation should result in correct cockpit visual indications. ADS-C should only be available through simulated real-world service providers that support ADS-C messaging.						✓	✓*	
9.10.7.S	AOC/DSP. AOC messages may be supported as required by the training objectives. DSP messages may be supported by the system if they serve as the communication medium for ATS clearance and weather messages. Other DSP messages fall outside of the scope of simulated ATC environment.						✓	✓*	The simulation of AOC is generally outside of the scope of simulated ATC environment, as AOC are usually company-specific.
9.10.8.S	Service failures. The system should be able to simulate service failures and recovery, including CPDLC service failures, as required by the training objectives. The instructor should have control over inducing a service failure.						✓	✓*	A data link service failure generally describes instances where lost messages, time delays or network failures result in improper system operation.

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.11	ATC VOICE CHARACTERISTICS								The generation of radio communications may be achieved manually or automated using synthetic speech technologies. Where the latter is used, the focus should be on achieving realistic voice audio delivered from ATC services over those from other entities. In order to prevent unnecessary confusion to the flight crew, an ATC voice should not be re-assigned to another function (such as a pilot) within the same training session.
9.11.1.S	Voice assignment (multiple). Multiple voices should be assigned to the ATC function.						✓	✓*	The number of voices should be sufficient to allow differentiation of the various ATC services.
9.11.1.G	Voice assignment. At least one voice should be assigned to the ATC function.	✓ MPL1	✓		✓	✓			The voices used need only be diverse enough to avoid confusion between ATC services and other functions.
9.11.2.S	Gender and accents. Where possible, gender mix and regional or international accents should be used for ATC services broadly to reflect the airport or geographical location.						✓	✓*	It may not be practical or cost effective to incorporate specific gender and regional or international accents; however, the aim should be that the background radio traffic broadly reflects ATC services.
9.12	INSTRUCTOR CONTROLS								
9.12.1. S,G	Access to radio communications. The instructor should have the ability to communicate directly with the flight crew for training and instruction, and have access to flight crew and ATC radio communications for monitoring and communicating.	✓ MPL1	✓		✓	✓	✓	✓*	
9.12.2. S,G	FSTD functions. The system should be able to accommodate the most common FSTD functions, such as total/flight freeze, resets and repositions.	✓ MPL1	✓		✓	✓	✓	✓*	
9.12.3. S,G	Disable. The system should provide the instructor with the ability to disable all simulated ATC environment functionality.	✓ MPL1	✓		✓	✓	✓	✓*	It is desirable that the system support the case where an instructor wishes to provide ATC services to the ownship manually, but also desires that other traffic be simulated along with associated background radio traffic.

Feature Technical Requirement Environment — ATC		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
9.12.4. S,G	Mute (background radio traffic). Background radio traffic audio output can be muted and then unmuted by the instructor.	✓ MPL1	✓		✓	✓	✓	✓*	While mute is enabled, the system should support continued background traffic simulation in real-time in order to minimize the impact on the wider traffic context and flight crew situational awareness.
9.12.5.S	Other training tools. Where applicable, it is desirable that simulated ATC environment support IOS-based lesson plans, debrief applications, and scenario development tools and applications.						✓	✓*	These features concern training efficiency and are intended to support training provision, rather than enhance realism. As such, they should not be considered necessary for training approval or device qualification.

10. REQUIREMENT — ENVIRONMENT — NAVIGATION

10.	Feature General Requirement Environment — Navigation	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
10.S	**Navigational data with the corresponding approach facilities to support the approved use.** **Navigation aids should be usable within range or line-of-sight without restriction, as applicable to the geographic area.**	✓	✓	✓	✓	✓	✓	✓	
10.R	**N/A.**								
10.G	**N/A.**								

Feature Technical Requirement Environment — Navigation		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
10.1	NAVIGATION DATABASE								
10.1.S	Navigation database sufficient to support simulated aeroplane systems for real-world operations.	✓	✓	✓	✓	✓	✓	✓	
10.1.R	N/A.								
10.1.G	N/A.								
10.2	MINIMUM AIRPORT REQUIREMENT								
10.2.S	Complete navigation database for at least 3 airports with corresponding precision and non-precision approach procedures, including regular updates.	✓	✓	✓	✓	✓	✓	✓	Regular updates means navigation database updates as mandated by the CAA.
10.2.R	N/A.								
10.2.G	N/A.								
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.
10.3.R	N/A.								
10.3.G	N/A.								
10.4	ARRIVAL/DEPARTURE FEATURES								
10.4.S	Navigational data with all the corresponding standard arrival and departure procedures.	✓	✓	✓	✓	✓	✓	✓	
10.4.R	N/A.								
10.4.G	N/A.								
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.
10.5.R	N/A.								
10.5.G	N/A.								

11. REQUIREMENT — ENVIRONMENT — ATMOSPHERE AND WEATHER

11.	Feature General Requirement Environment — Atmosphere and Weather	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
11.S	**N/A.**								
11.R	**Fully integrated dynamic environment simulation including a representative atmosphere with weather effects to support the approved 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 approved use.** **The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity.**	✓	✓	✓	✓				

Feature Technical Requirement Environment — Atmosphere and Weather		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
11.1	STANDARD ATMOSPHERE								
11.1.S	N/A.								
11.1. R,G	Simulation of the standard atmosphere including instructor control over key parameters.	✓	✓	✓	✓	✓	✓	✓	
11.2	WIND SHEAR								
11.2.S	N/A.								
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.					✓	✓	✓	See Appendix B, test 2.g (wind shear). 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 Royal Aeroplane Establishment (RAE) *Wind Shear Training*, the *Joint Airport Weather Studies (JAWS) Project* and other recognized 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 for recognition of wind shear phenomena.	✓		✓					A subjective test is required. See Appendix C for similar examples.
11.3	WEATHER EFFECTS								
11.3.S	N/A.								
11.3.R (ctd next page)	The following weather effects as observed on the visual system should be simulated and respective instructor controls provided. (1) Multiple cloud layers with adjustable bases, tops, sky coverage and scud effect.					✓	✓	✓	A subjective test is required. See Appendix C for similar examples.
	(2) Storm cells activation and/or deactivation.					✓	✓	✓	
	(3) Visibility and runway visual range (RVR), including fog and patchy fog effects.					✓	✓	✓	Objective test required. See Appendix B, test 4.d (visual ground segment).
	(4) Effects on ownship external lighting.					✓	✓	✓	
	(5) Effects on airport lighting (including variable intensity and fog effects).					✓	✓	✓	
	(6) Surface contaminants (including wind blowing effect).					✓	✓	✓	

Feature Technical Requirement Environment — Atmosphere and Weather		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
11.3.R (ctd)	(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 aeroplane being simulated. 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.					✓	✓	✓	This feature can be applied to Type V, VI and VII devices where required. 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 aeroplane being simulated. The use of scenarios is encouraged.
11.3 G	The following weather effects as observed on the visual system should be simulated and respective instructor controls provided.								A subjective test is required. See Appendix C.
	(1) Visibility.	✓	✓	✓	✓				
11.4	INSTRUCTOR CONTROLS								
11.4.S	N/A.								
11.4. R,G	The following features should be simulated with appropriate instructor controls provided:								A subjective test is required. See Appendix C. For devices without motion, effects should be simulated on the instruments.
	(1) surface wind speed, direction and gusts;	✓	✓	✓	✓	✓	✓	✓	
	(2) intermediate and high altitude wind speed and direction;					✓	✓	✓	
	(3) thunderstorms and microbursts; and	✓		✓		✓	✓	✓	
	(4) turbulence.	✓	✓	✓	✓	✓	✓	✓	

12. REQUIREMENT — ENVIRONMENT — AERODROMES AND TERRAIN

12.	Feature General Requirement Environment — Aerodromes and Terrain	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
12.S	N/A.								
12.R	Specific airport models with topographical features to support the approved 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 type, e.g. low visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting.	✓ PPL			✓	✓	✓	✓	*Note.— The requirements should be read in conjunction with Appendix C, section 12 to fully understand the details to be provided.*
12.R(S)	Specific airport models with topographical features to support the approved 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. For specific VFR cross-country training the capability to replicate ground visual references and topographical features sufficient to support VFR navigation according to appropriate charts — minimum standard 1:500 000 scale mapping.	✓ PPL							
12.G	Generic airport models with topographical features to support the approved use. Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways.	✓ CPL MPL1	✓	✓					*Note.— The requirements should be read in conjunction with Appendix C, section 12 to fully understand the details to be provided.*

12.	Feature General Requirement Environment — Aerodromes and Terrain	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
12.G(S)	**Generic airport models with topographical features to support the approved use.** **Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways.** **For specific VFR cross-country training the capability to replicate ground visual references and topographical features sufficient to support VFR navigation according to appropriate charts — minimum standard 1:500 000 scale mapping.**	**✓ CPL**							

Feature Technical Requirement Environment — Aerodromes and Terrain		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
12.1	VISUAL CUES								
12.1.1. R(S), G(S)	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 (3) highly detailed and accurate surface depiction of the terrain surface within an area sufficient to achieve cross-country flying under VFR conditions.	✓ PPL CPL							
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 (3) highly detailed and accurate surface depiction of the terrain surface within an approximate area from 400 m (1/4 sm) before the runway approach end to 400 m (1/4 sm) beyond the runway departure end with a total width of approximately 400 m (1/4 sm) including the width of the runway.	✓ PPL			✓	✓	✓	✓	

Feature Technical Requirement Environment — Aerodromes and Terrain		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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.	✓ CPL MPL1	✓	✓					
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.	✓ PPL			✓	✓	✓	✓	*Note.— For Type I, PPL, "(3) glow associated with approach lights in low visibility before physical lights are seen" is not required.*
12.3	ENVIRONMENT ATTITUDE								
12.3.1. S,R,G	The FSTD 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.a.R	The system should include at least three designated real-world airports available in daylight, twilight (dusk or dawn) and night illumination states.				✓	✓	✓	✓	The designated real-world airports should be part of the approved training programme.
12.4.1.b.R	The system should include at least one designated real-world airport available in daylight, twilight (dusk or dawn) and night illumination states.	✓ PPL							The designated real-world airport(s) should be part of the approved training programme.
12.4.1.G	The system should include a generic airport available in daylight, twilight (dusk or dawn) and night illumination states.	✓ CPL MPL1	✓	✓					
12.4.2.1. S,R,G	Daylight capability.	✓	✓	✓	✓	✓	✓	✓	SOC required for system capability. System objective tests are required. See Appendix B, test 4.a (visual scene quality). Scene content tests are also required. See Appendix C.

Feature Technical Requirement Environment — Aerodromes and Terrain		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
12.4.2.2. S,R,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.	✓ PPL			✓	✓	✓	✓	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.	✓ PPL			✓	✓	✓	✓	
12.4.2.4. G	Total scene content should be sufficient to identify the airport and represent the surrounding terrain.	✓ CPL MPL1	✓	✓					
12.4.2.5. R	The system should have sufficient capacity to display 16 simultaneously moving objects.	✓ PPL			✓	✓	✓	✓	
12.4.3.1. S,R	Twilight (dusk) capability.	✓ PPL CPL			✓	✓	✓	✓	
12.4.3.2. S,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).	✓ PPL CPL			✓	✓	✓	✓	
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.	✓ PPL			✓	✓	✓	✓	
12.4.3.3. 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).	✓ PPL			✓	✓	✓	✓	
12.4.3.4. S,R	The system should include a definable horizon.	✓ PPL CPL			✓	✓	✓	✓	If provided, directional horizon lighting should have correct orientation and be consistent with surface shading effects.
12.4.3.6. R	The system should have sufficient capacity to display 16 simultaneously moving objects.	✓ PPL			✓	✓	✓	✓	

Feature Technical Requirement Environment — Aerodromes and Terrain		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
12.4.4. S,R	Night capability.	✓ PPL CPL			✓	✓	✓	✓	
12.4.4.1. S,R	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).	✓ PPL			✓	✓	✓	✓	
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.	✓ PPL			✓	✓	✓	✓	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								Applicable to Type VII devices only.
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.							✓	Selection of the airport scenes to be agreed with the CAA. Changes should be incorporated in the simulator database within six months of being implemented in the corresponding real-world airport. 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 recognizable 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.

Feature Technical Requirement Environment — Aerodromes and Terrain		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
12.7	VISUAL SYSTEM FOR REDUCED FOV								Applies only to Type I FSTD when used to support CPL and MPL1 training, and to Type II FSTD when used to support IR training, both applications allowing the use of a reduced FOV visual system.
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.	✓ CPL MPL1	✓						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.	✓ CPL MPL1	✓						
12.8	VFR TRAINING								
12.8.1.S	The system, when used for VFR training, should include a database area that can support a 300 nautical miles triangular flight incorporating three airports. Within the defined area the system should replicate ground visual references and topographical features sufficient to support VFR navigation according to appropriate charts.	✓ CPL PPL							Applies only to Type I FSTD when used for VFR operations to support CPL and PPL training. Correlation should be with 1:500 000 scale VFR Navigation Charts at a minimum, or larger scales (e.g. 1:250 000) if applicable to the area.
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 type, e.g. low visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting.						✓	✓	

13. REQUIREMENT — MISCELLANEOUS

13.	Feature General Requirement Miscellaneous	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
13.S	**N/A.**								
13.R	**N/A.**								
13.G	**N/A.**								

Feature Technical Requirement Miscellaneous		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
13.1	INSTRUCTOR OPERATING STATION								
13.1.S	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.
13.1.R	The instructor station should provide an adequate view of the pilots' panels and forward windows.	✓	✓	✓	✓				
13.1.G	N/A.								
13.2	INSTRUCTOR CONTROLS								
13.2. S,R,G	Instructor controls should be provided for all required system variables, freezes and 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.	✓	✓	✓	✓	✓	✓	✓	
13.2.1.S (ctd next page)	The instructor station should provide adequate feedback and support of the aeroplane and controls state during upset prevention and recovery training (UPRT) exercises. This should include: (1) FSTD validation envelope. This should be in the form of an alpha/ beta envelope (or equivalent method) depicting the "confidence level" of the aerodynamic model depending on the degree of flight validation or source of predictive methods. The envelopes should provide the instructor real-time feedback on the simulation during a manoeuvre. There should be a minimum of a flaps up and flaps down envelope available. This presentation should include a time history and should be available for debrief purposes; (2) Flight control positions. This should enable the instructor to assess the pilot's flight control inputs. It should include rudder pedal displacement and control forces as well as the primary control channels (including fly-by-wire as appropriate). The tool should display feedback in real time, and record parameters for displaying a time history and for debrief purposes; and							✓	Only required for UPRT training. For examples of the instructor feedback mechanism, see Attachment P. For the operational limits it is highly recommended that normal load factor (n) and airspeed (V) limits be displayed on a V-n display bounded by operational load limits and operating speeds. This display should be constructed in accordance with the OEM data and should incorporate the OEM's operating recommendations.

Feature Technical Requirement Miscellaneous		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
13.2.1.S (ctd)	(3) Aeroplane operational limits. This should display the aircraft operating limits during the manoeuvre applicable for the configuration of the aeroplane. The information should be displayed in real time and recorded for debrief. The time history should be displayed graphically in a format that makes information available and useful to the instructor.								
13.2.2.S	Selectable aeroplane upsets should be provided and supported by guidance to the instructor concerning the method utilized to drive the FSTD into an upset condition including any malfunction or degradation in the FSTD's functionality required to initiate the upset.							✓	Only required for UPRT training. The following minimum set of upset recovery manoeuvres should be available to the instructor: — a nose high, wings level aircraft upset; — a nose low, wings level aircraft upset; and — a high bank angle aircraft upset. Other upset recovery scenarios as developed by the FSTD operator should be evaluated in the same manner. The intentional degradation of FSTD functionality to drive an aeroplane upset is generally not acceptable unless used purely as a tool for repositioning with the pilot out of the loop. *Note.— Care should be taken with flight envelope protected aeroplanes, as artificially positioning the aeroplane to a specified attitude may not be representative because the flight control law may not be correctly initialized.*
13.3	SELF—DIAGNOSTIC TESTING								
13.3.S	Self-diagnostic testing of the 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.					✓	✓	✓	SOC required.

Feature Technical Requirement Miscellaneous		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
13.4	COMPUTER CAPACITY								
13.4. S,R,G	Sufficient FSTD computer capacity, accuracy, resolution and dynamic response should be provided to fully support the overall FSTD fidelity needed to meet the qualification type sought.	✓	✓	✓	✓	✓	✓	✓	SOC required.
13.5	AUTOMATIC TESTING FACILITIES								
13.5.S	Automatic QTG/validation testing of FSTD hardware and software to determine compliance with the validation requirements 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 standard.
13.5.R,G	Validation testing of FSTD hardware and software 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 Master QTG test standard. Automatic QTG validation/testing is encouraged.
13.6	UPDATES TO FSTD HARDWARE AND SOFTWARE								
13.6.S,R	Timely permanent update of FSTD hardware and software should be conducted subsequent to aeroplane modification where it affects training, sufficient for the qualification type sought.	✓		✓		✓	✓	✓	
13.6.G	Timely permanent update of FSTD hardware and software should be conducted subsequent to FSTD manufacturer recommendation where it affects training and/or safety.		✓		✓				
13.7	DAILY PRE-FLIGHT DOCUMENTATION								
13.7. S,R,G	Daily pre-flight documentation either in the daily log or in a location easily accessible for review is required.	✓	✓	✓	✓	✓	✓	✓	

Feature Technical Requirement Miscellaneous		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
13.8	SYSTEM INTEGRATION								
13.8	System Integration: Relative response of the visual system, flight deck instruments and initial motion system coupled closely to provide integrated sensory cues. 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. 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. 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 CAA.								Test required. See Appendix B, test 6.a (transport delay). Latency test may be used as an alternate means of compliance in place of the transport delay test. Attachment G provides guidance for transport delay and for latency test methodology.
13.8.S	Transport delay: A transport delay test may be used to demonstrate that the FSTD system response does not exceed 100 ms for the motion and instrument systems and 120 ms for the visual system. Where EFVS systems are installed, they should respond within ±30 ms from the visual system response, and not before motion system response.					✓		✓	Results required for instruments, motion and visual systems. Additional transport delay test results are required where HUD 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.
13.8. R,G	Transport delay: A transport delay test may be used to demonstrate that the FSTD system response does not exceed 200 ms.	✓	✓	✓	✓		✓		Results required for applicable systems only.

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Appendix B

FSTD VALIDATION TESTS

1. INTRODUCTION

1.1 FSTD performance and system operation should be objectively evaluated by comparing the results of tests conducted in the FSTD to validation data, unless specifically noted otherwise. The validation, functions and subjective tests required for the QTG enable the evaluator to "spot check" the performance of the FSTD in order to confirm that it represents the aeroplane in some significant training or testing and checking areas. Without such spot checking using the QTG, FSTD performance cannot be verified in the time normally available for the regulatory evaluation. It should be clearly understood that the QTG does not provide for a rigorous examination of the quality of the simulation in all areas of flight and systems operation. The full testing of the FSTD simulation is intended to have been completed by the FSTD manufacturer's and the FSTD operator's personnel prior to the FSTD being submitted for the regulatory evaluation and prior to the delivery of the results in the QTG. This "in depth" testing is a fundamental part of the whole cycle of testing and is normally carried out using documented acceptance test procedures in which the test results are recorded. These procedures will test the functionality and performance of many areas of the simulation that are not addressed in the QTG as well as such items as the instructor operating station. To facilitate the validation of the FSTD using the QTG, an appropriate recording device acceptable to the CAA should be used to record each validation test result. These recordings should then be compared to the validation data. The QTG validation tests should be documented, considering the following:

a) the FSTD QTG should describe clearly and distinctly how the FSTD will be set up and operated for each test. Use of a driver programme designed to automatically accomplish the tests is required. It is not the intent, nor is it acceptable, to test each FSTD sub-system independently. Overall integrated testing of the FSTD, with test inputs at the pilot controls, should be accomplished to assure that the total FSTD system meets the prescribed standards;

b) to ensure compliance with this intent, QTGs should contain explanatory material which clearly indicates how each test (or group of tests) is executed, e.g. which parameters are driven/free/constrained and the use of closed/open loop drivers; and

c) all QTG validation tests based on flight test data should also be able to be run manually in order to validate the automatic test results. Short-term tests with simple inputs should be easily reproduced manually. Longer term tests with complex inputs are unlikely to be easily duplicated.

1.2 Certain visual and motion tests in this appendix 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.

1.3 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. The manual test results should be able to be achieved using the same tolerances as those utilized for the automatic test. Manual test results may not meet the tolerances; however the CAA evaluator should be confident they could meet the tolerances if enough effort was spent trying to reproduce the pilot inputs exactly.

1.4 Submission for approval of data other than flight test should include an explanation of validity with respect to available flight test information. Tests and tolerances in this appendix should be included in the FSTD QTG. For aeroplanes certificated after 1 January 2002, the QTG should be supported by a validation data roadmap (VDR) as described in Attachment D. Data providers are encouraged to supply a VDR for older aeroplanes.

1.5 The table of FSTD validation tests in this appendix indicates the required tests. Unless noted otherwise, FSTD tests should represent aeroplane performance and handling qualities at operating mass and centre of gravity (cg) positions typical of normal operation. If a test is supported by aeroplane data at one extreme mass or cg position, another test supported by aeroplane data at mid-conditions or as close as possible to the other extreme should be included. Certain tests which are relevant only at one extreme mass or cg position need not be repeated at the other extreme. Tests of handling qualities should include validation of augmentation devices.

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

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

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

1.7 The recording requirements of 1.6 a) and b) apply to both normal and non-normal states. All tests in the table of FSTD validation tests 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.

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

1.9 Tests affected by normal, non-normal or other degraded control states not possible in the approved operating envelope of the aeroplane being simulated, and for which results cannot be provided, should be addressed in the QTG by an appropriate rationale included from the aeroplane manufacturer's VDR.

2. TEST REQUIREMENTS

2.1 The ground and flight tests required for qualification are listed in the table of FSTD validation tests. Computer-generated FSTD test results should be provided for each test. The results should be produced on an appropriate recording device acceptable to the CAA. Time histories are required unless otherwise indicated in the table of FSTD validation tests.

2.2 In cases where the objective test results authorize a "snapshot test" or a "series of snapshot tests" in lieu of a time history, the data provider should ensure that a steady state condition exists at the instant of time captured by the "snapshot". This is often verified by showing that a steady state condition existed from some period prior to, through some period following, the snapshot. The time period most frequently used is from 5 seconds prior to, through 2 seconds following, the instant of time captured by the snapshot. This paragraph is primarily addressing the validation data and the method by which the data provider ensures that the steady state condition for the snapshot is representative.

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

2.4 *Parameters, tolerances and flight conditions*. The table of FSTD validation tests 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. Regardless, the test should exhibit correct trends. FSTD results should be labelled using the tolerances and units given, considering the following:

a) the tolerances for some of the objective tests have been reduced to “Correct Trend and Magnitude” (CT&M). The use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. For such tests, the performance of the device should be appropriate and representative of the simulated designated aeroplane and should under no circumstances exhibit characteristics that could lead to negative training;

b) the tolerances listed for tests noted as CT&M are applicable for recurrent evaluations and should be applied to ensure the device remains at the standard initially qualified. Where CT&M is noted, it is required that an automatic recording system be used to “footprint” the baseline results thereby avoiding the effects of possible divergent subjective opinions during recurrent evaluations;

c) for parameters that have units of per cent, or parameters normally displayed in the cockpit in units of per cent (e.g. N_1, N_2, engine torque or power), then a percentage tolerance will be interpreted as an absolute tolerance unless otherwise specified (i.e. for an observation of 50 per cent N_1 and a tolerance of 5 per cent, the acceptable range would be from 45 per cent to 55 per cent); and

d) for parameters not displayed in units of per cent, a tolerance expressed only as a percentage will be interpreted as the percentage of the current reference value of that parameter during the test, except for parameters varying around a zero value for which a minimum absolute value should be agreed with the CAA.

2.5 *Flight condition verification*. When comparing the parameters listed to those of the aeroplane, sufficient data should also be provided to verify the correct flight condition. For example, to show the control force is within ±2.2 daN (5 lbf) 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, 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 clearly annotated as to indicated, calibrated, etc., and like values used for comparison.

2.6 *Flight condition definitions*. The flight conditions specified in the table of FSTD validation tests, sections 1 (Performance) and 2 (Handling Qualities) are defined 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;

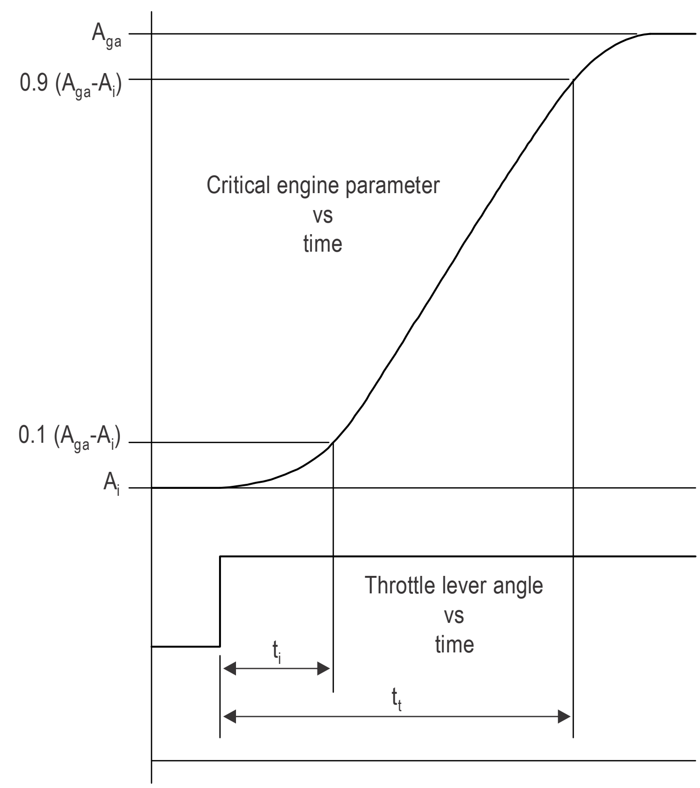
f) approach — gear up or down with flaps at any normal approach position as recommended by the aeroplane manufacturer; and

g) landing — gear down with flaps in any certified landing position.

3. INFORMATION FOR VALIDATION TESTS

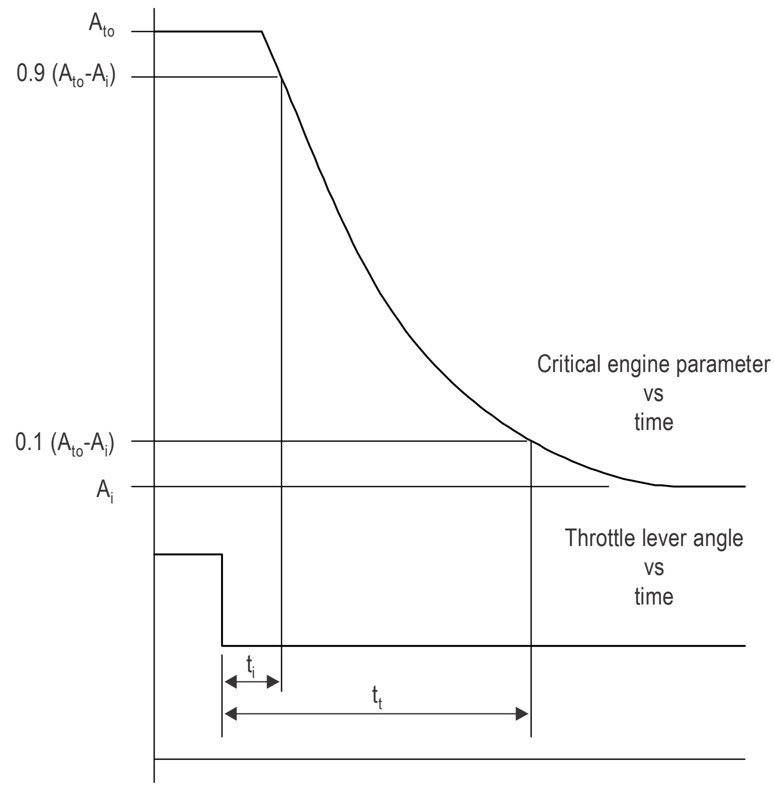
3.1 Engines

3.1.1 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 B-1 and B-2.



A_{ga} = Critical engine parameter at go-around power
A_i = Critical engine parameter at idle power
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

Figure B-1. Engine acceleration



A_{to} = Critical engine parameter at maximum take-off power
A_i = Critical engine parameter at idle power
t_i = Total time from initial throttle movement until a critical engine parameter reaches 10% of its total response below maximum take-off power
t_t = 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

Figure B-2. Engine deceleration

3.2 Control dynamics

3.2.1 *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.

3.2.1.1 Recordings such as free response to a pulse or step function are traditionally 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 control dynamics tests are indicated in 2.b.1 through 2.b.3 of the table of FSTD validation tests.

3.2.1.2 Control dynamics characteristics are usually assessed 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.

3.2.1.3 For aeroplanes with irreversible control systems, measurements may be obtained on the ground if proper pitot-static inputs 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 will not be required during initial and upgrade evaluations if the QTG 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.

3.2.2 *Control dynamics evaluation.* The dynamic properties of control systems are often stated in terms of frequency, damping and a number of other traditional 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 will clearly define the interpretation of the measurements and the tolerances to be applied. Criteria are needed for underdamped, critically damped and overdamped systems. In the case of an underdamped system with very light damping, the system may be quantified in terms of frequency and damping. In critically damped or overdamped systems, the frequency and damping are not readily measured from a response time history. Therefore, some other measurement should be used.

3.2.2.1 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 for the underdamped and critically damped cases. The response is as follows:

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

   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 per cent of the total initial displacement should be considered. The residual band, labelled $T(A_d)$ on Figure B-3, is ±5 per cent of the initial displacement amplitude A_d from the steady state value of the oscillation, or ±0.5 per cent of the total control travel (stop to stop). Only oscillations outside the residual band are considered significant. When comparing FSTD data to aeroplane data, the process should begin by overlaying or aligning the FSTD and aeroplane displacement values and then comparing amplitudes of oscillation peaks, the time to the first zero crossing and individual periods of oscillation. The FSTD should show the same number of significant overshoots to within one when compared against the aeroplane data. This procedure for evaluating the response is illustrated in Figure B-3.

b) *Critically damped and overdamped response*. Due to the nature of critically damped and overdamped responses (no overshoots), the time to travel from 90 per cent of the initial displacement to 10 per cent of the steady state (neutral point) value should be the same as the aeroplane within ±10 per cent or ±0.05 s. Figure B-4 illustrates the procedure.

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

3.2.2.2 *Tolerances.* The following table summarizes the tolerances, T for underdamped systems. See Figure B-3 for an illustration of the referenced measurements.

$T(P_0)$	±10 per cent of P_0 or ±0.05 s.
$T(P_1)$	±20 per cent of P_1 or ±0.05 s.
$T(P_2)$	±30 per cent of P_2 or ±0.05 s.
$T(P_n)$	±10(n+1) per cent of P_n or ±0.05 s.
$T(A_n)$	±1 per cent of A_{max}, where A_{max} is the largest amplitude or ±0.5 per cent of the total control travel (stop to stop).
$T(A_d)$	±5 per cent of A_d = residual band or ±0.5 per cent 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.

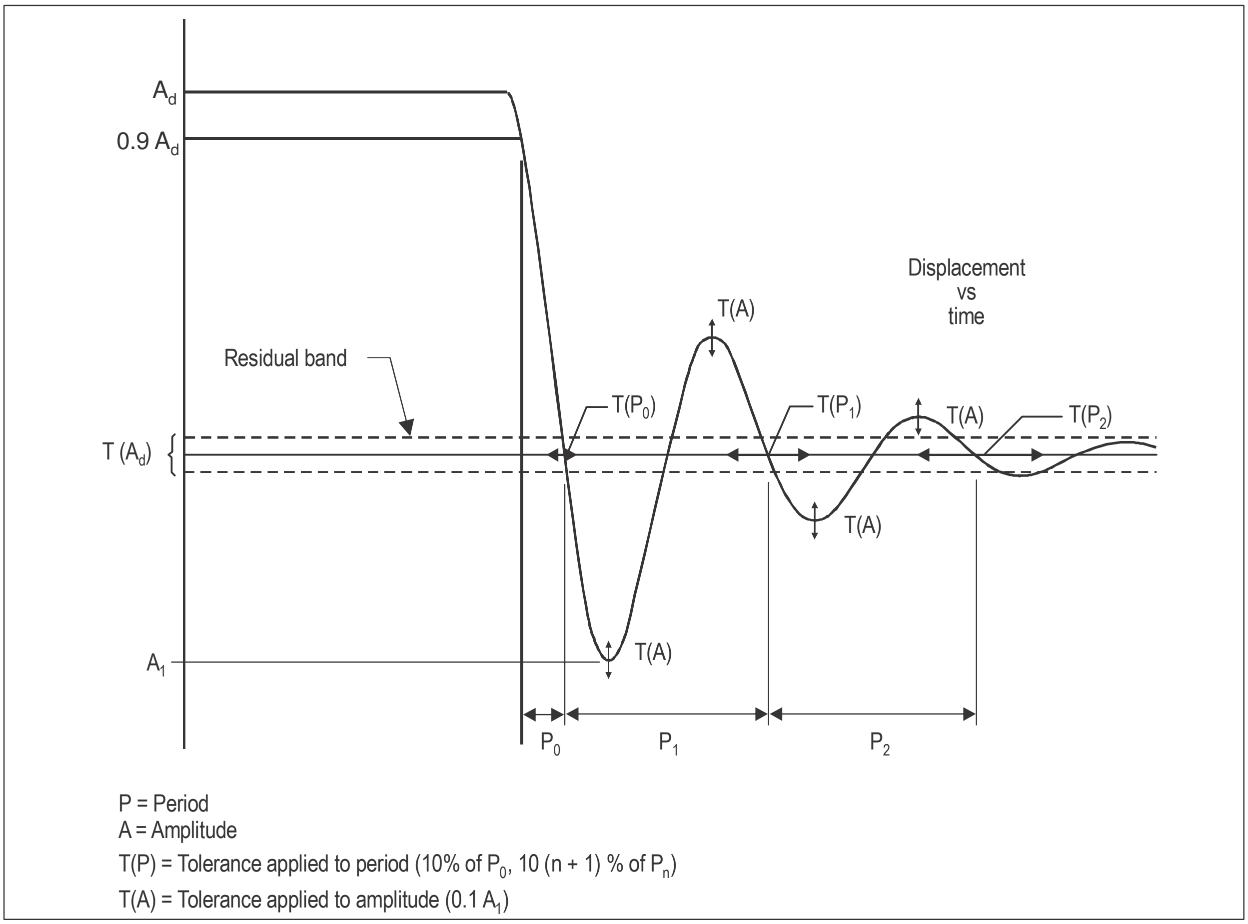


Figure B-3 Underdamped step response

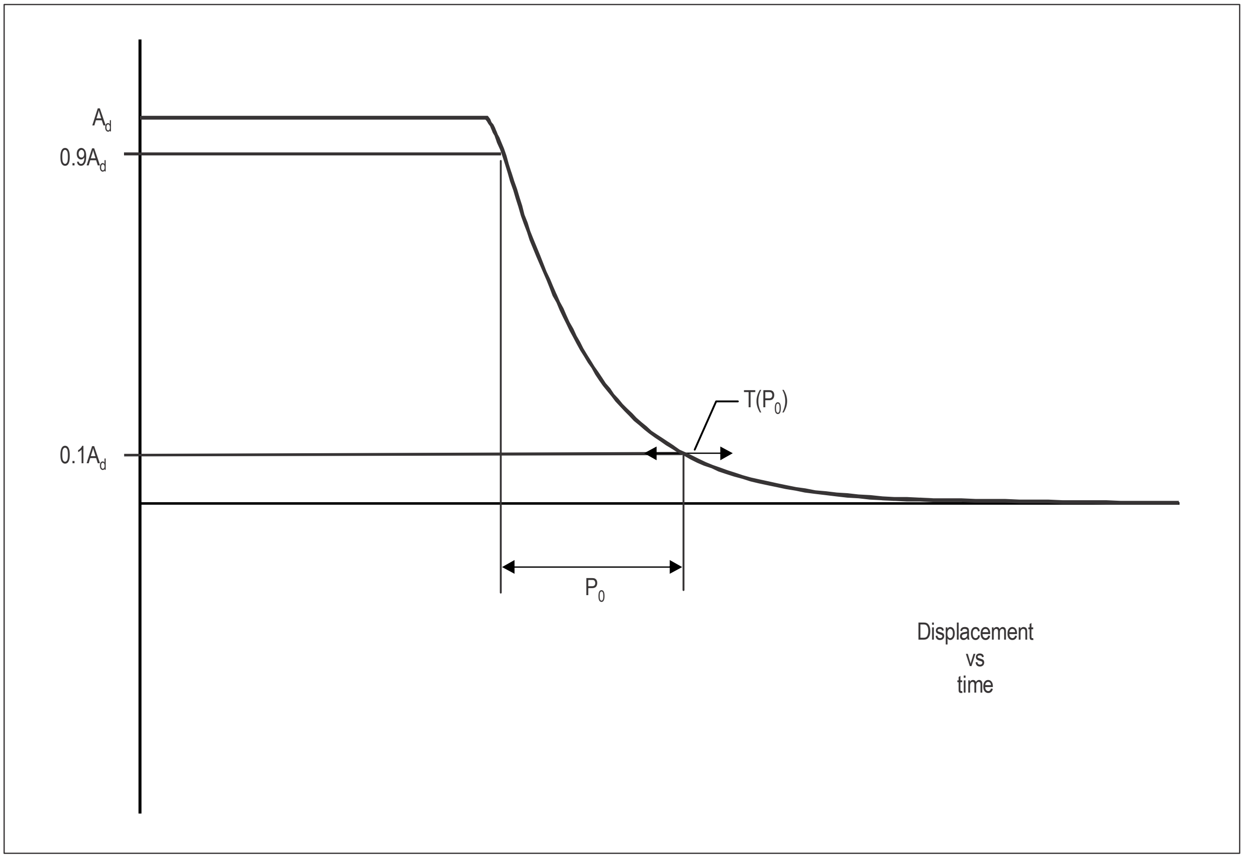


Figure B-4   Critically damped step response

The following tolerance applies only to the overdamped and critically damped systems (see Figure B-4 for an illustration of the reference measurement):

$T(P_0)$ ±10 per cent of P_0 or ±0.05 s.

3.2.3   *Alternate method for control dynamics evaluation of irreversible flight controls*. One aeroplane manufacturer has proposed, and its CAA 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.

3.2.3.1   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:

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

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

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

Note.— Dynamic sweeps may be limited to forces not exceeding 44.5 daN (100 lbf).

3.2.3.2 *Tolerances*.

a) Static test. Items 2.a.1, 2.a.2 and 2.a.3 of the table of FSTD validation tests.

b) Dynamic test. ±0.9 daN (2 lbf) or ±10 per cent of dynamic increment above static test.

3.2.3.3 CAAs are open to alternative means such as the one described in 3.2.3. 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 CAA find that alternative methods do not result in satisfactory performance, more conventionally accepted methods should then be used.

3.2.4 *Alternate method for control dynamics evaluation of flight controls with atypical response*. Dynamic responses exhibiting atypical behaviour, as frequently seen on reversible controls, may be evaluated using an alternate reference line better suited for such cases. This alternate line is based on the dynamic response itself and attempts to better approximate the true rest position of the control throughout the step response. A full discussion on how to compute the alternate reference line is provided in Attachment N. Figure B-5 shows the final result and how to apply the tolerances using the new reference.

3.2.5 A flight control dynamic response is considered atypical when it does not exhibit classic second order system behaviour. For underdamped systems, the key features of such a behaviour are a constant period, decaying overshoots (an overshoot is always smaller than the previous one) and a fixed steady state position. Overdamped systems show a control position that will demonstrate a smooth exponential decay from its initial displacement towards a fixed steady state position.

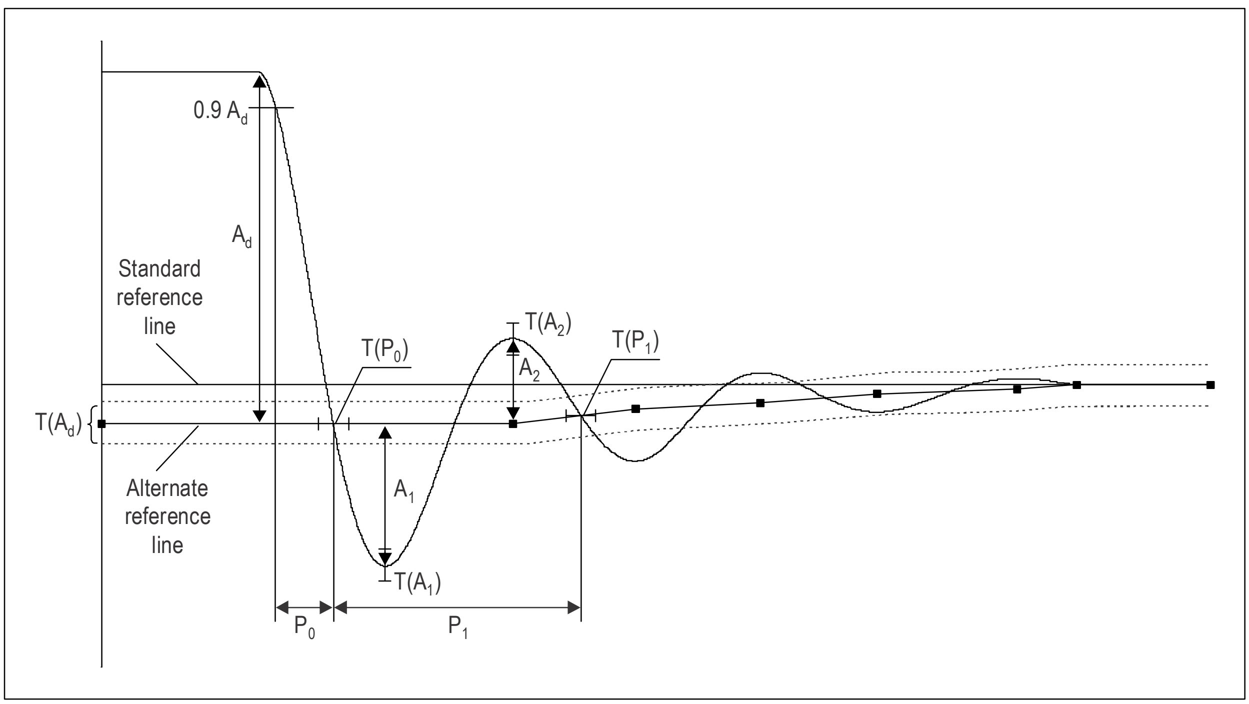


Figure B-5 Tolerances applied using the alternate reference line

3.3 Ground effect

3.3.1 An FSTD to be used for take-off and landing 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 which will validate the aerodynamic ground effect characteristics should be undertaken. The choice of the test method and procedures to validate ground effect rests with the organization performing the flight tests; however, the duration of the flight test performed near the ground should be sufficient to validate the ground-effect model.

3.3.2 Acceptable tests for validation of ground effect should include one of the following:

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

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

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

3.3.3 The lateral-directional characteristics are also altered by ground effect. For example, because of changes in lift, roll damping is affected. The change in roll damping will affect other dynamic modes usually evaluated for FSTD validation. In fact, Dutch roll dynamics, spiral stability and roll rate for a given lateral control input are altered by ground effect. Steady heading sideslips will also be affected. These effects should be accounted for in the simulator 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 while transiting heights at which ground effect is an important factor.

3.4 Engineering simulator validation data

3.4.1 When a fully flight test validated simulation is modified as a result of changes to the simulated aeroplane configuration, a qualified aeroplane manufacturer may, with the prior agreement of the relevant CAA:

a) 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 which are both easily understood and well defined; or

b) support the most recent data package using engineering simulator validation data, and track only the latest version of test requirements.

When the FSTD operator receives appropriate validation data from the approved data provider and receives approval from the CAA, the FSTD operator may adopt tests and associated tolerances described in the current qualification standards as the tests and tolerances applicable for the continuing qualification of a previously qualified FSTD. The updated test(s) and tolerance(s) should be made a permanent part of the MQTG.

3.4.2 To be qualified to supply engineering simulator validation data, an aeroplane manufacturer, or other approved data supplier, should:

a) have a proven track record of developing successful data packages;

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

c) have an engineering simulator that:

1) has models which run in an integrated manner;

2) uses the same models as those released to the training community (which are also used to produce stand-alone proof-of-match and check-out documents);

3) is used to support aeroplane development and certification;

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

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

3.4.3 Aeroplane manufacturers seeking to take advantage of this alternative arrangement should contact the CAA at the earliest opportunity.

3.4.4 For the initial application, each applicant should demonstrate its ability to qualify to the satisfaction of the CAA, in accordance with the means provided in this appendix and Attachment B.

3.5 Motion system

3.5.1 *General*

3.5.1.1 Pilots use continuous information signals to manage 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 objective performance criteria as well as be 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.

3.5.1.2 The objective validation tests presented in this appendix are intended to qualify the FSTD motion cueing system from both a mechanical performance standpoint and a motion cueing fidelity perspective.

3.5.2 *Motion system checks*. The intent of tests 3.a (frequency response) and 3.b (turn-around check), as described in the table of FSTD validation tests, 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.

3.5.3 *Motion cueing fidelity tests*

3.5.3.1 Frequency-domain based objective motion cueing test

3.5.3.1.1 Background. This test quantifies the response of the motion cueing system from the output of the flight model to the motion platform response. Other motion tests, such as the motion system frequency response, concentrate on the mechanical performance of the motion system hardware alone. The intent of this test is to provide quantitative frequency response records of the entire motion system for specified degree-of-freedom transfer relationships over a range of frequencies. This range should be representative of the manual control range for that particular aeroplane type and the FSTD as set up during qualification. The measurements of this test should include the combined influence of the motion cueing algorithm, the motion platform dynamics, and the transport delay associated with the motion cueing and control system implementation. Specified frequency responses describing the ability of the FSTD to reproduce aeroplane translations and rotations, as well as the cross-coupling relations, are required as part of these measurements. When simulating forward aeroplane acceleration, the FSTD is accelerated momentarily in the forward direction to provide the onset cueing. This is considered the direct transfer relation. The FSTD is simultaneously tilted nose-up due to the low-pass filter in order to generate a sustained specific force. The tilt associated with the generation of the sustained specific force, and the angular rates and angular accelerations associated with the initiation of the sustained specific force, are considered cross-coupling relations. The specific force is required for the perception of the aeroplane sustained specific force, while the angular rates and accelerations do not occur in the aeroplane and should be minimized.

3.5.3.1.2 Frequency response test. This test requires the frequency response to be measured for the motion cueing system. Reference sinusoidal signals are inserted at the pilot reference position prior to the motion cueing computations (see Figure B-6). The response of the motion platform in the corresponding degree-of-freedom (the direct transfer relations), as well as the motions resulting from cross-coupling (the cross-coupling relations), are recorded. These are given in Table B-1. These are the tests that are important to pilot motion cueing and are general tests applicable to all types of aeroplanes. These tests can be run at any time deemed acceptable to the CAA prior to and/or during the initial qualification. The test requirement can be satisfied by a statement of compliance (SOC) supported with the relevant objective tests and which should be provided by the FSTD manufacturer following factory testing. It should not be necessary to run these tests for evaluations at the FSTD operator site unless changes are made to the motion cueing algorithms and associated parameters.

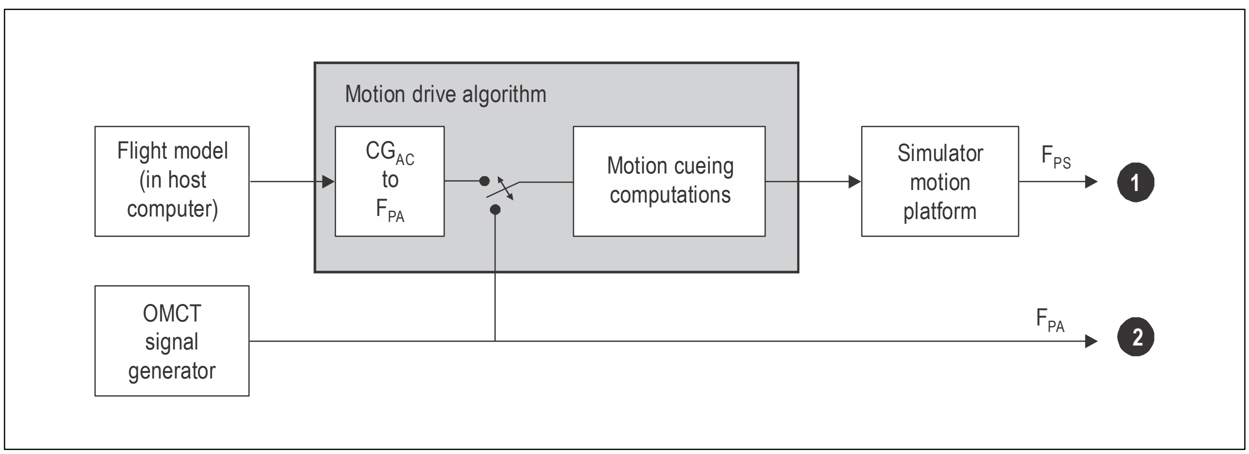


Figure B-6. Schematic of measured input ❷ and output ❶ relation for frequency-domain motion cueing test.

Table B-1. Motion cueing system transfer test matrix

	FSTD response output					
Aircraft input signal	**Pitch**	**Roll**	**Yaw**	**Surge**	**Sway**	**Heave**
Pitch	1			2		
Roll		3			4	
Yaw			5			
Surge	7			6		
Sway		9			8	
Heave						10

3.5.3.1.3 The frequency responses describe the relations between aeroplane motions and simulator motions as defined in Table B-1. The relations are explained below per individual test. 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.

1) FSTD pitch response to aeroplane pitch input;

2) FSTD surge acceleration response due to aeroplane pitch acceleration input;

3) FSTD roll response to aeroplane roll input;

4) FSTD sway specific force response due to aeroplane roll acceleration input;

5) FSTD yaw response to aeroplane yaw input;

6) FSTD surge response to aeroplane surge input;

7) FSTD pitch response to aeroplane surge specific force input;

8) FSTD sway response to aeroplane sway input;

9) FSTD roll response to aeroplane sway specific force input; and

10) FSTD heave response to aeroplane heave input.

3.5.3.1.4 Frequencies. The tests should be conducted by introducing sinusoidal inputs at discrete input frequencies entered at the output of the flight model, transformed to the pilot reference position just before the motion cueing computations, and measured at the response of the FSTD platform. The twelve discrete frequencies for these tests range from 0.100 rad/s to 15.849 rad/s and are given in Attachment F, Table F-1. The relationship between the frequency and corresponding measured modulus and phase defines the system transfer function. This test requires that, for each degree-of-freedom, measurements at the twelve specified frequencies should be taken.

3.5.3.1.5 Input signal amplitudes. The tests applied here to the motion cueing system are intended to qualify its response to normal control inputs during manoeuvring (i.e. not aggressive or excessively hard control inputs). It is 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. The sinusoidal input signal amplitudes are defined in Attachment F, Tables F-2 and F-4.

3.5.3.1.6 Data recording. The measured parameters for each test should include the modulus and phase as prescribed in Attachment F, 2.2, for the tests delineated in Table B-1. The modulus indicates the amplitude ratio of the output signal divided by the input signal, expressed in non-dimensional terms in case of the direct transfer relations (1, 3, 5, 6, 8, and 10) and in dimensional terms in the case of the cross-coupling relations (2, 4, 7, and 9). The phase describes the delay at that frequency between the output signal and the input signal, and is expressed in degrees.

3.5.3.1.7 Frames of reference. Measurements of the FSTD response should be transformed to estimated measurements at the pilot reference frame. This is defined as being attached to the FSTD in the plane of symmetry of the cab, at a height approximately 35 cm below pilot eye height. The x-axis points forward and the z-axis points downward. The frames of reference are defined in Attachment F, 8.4.

3.5.3.1.8 Aeroplane characteristics. The tests should be conducted in the FSTD configuration representing the motion drive algorithm during the flight mode. If the motion drive algorithm parameters are different in the ground mode (for example during taxi or take-off roll), the tests should be repeated for this configuration. If to be performed, the recommended conditions on ground are low speed taxi at 10 kt and approach to take-off speed at 80 kt.

3.5.3.1.9 Presentation of results. The measured modulus and phase should be tabulated for the twelve discrete frequencies and for each of the transfer relations given in Table B-1. The results should also be plotted for each component in bode plots. The modulus and phase should be presented as a function of frequency in rad/s. The modulus should be presented in a log-log plot, the phase in a semi-log plot. An example is shown in Figure B-7.

3.5.3.1.10 Tolerances. The boundaries of the criteria for the ten tests are presented in Attachment F, section 7.

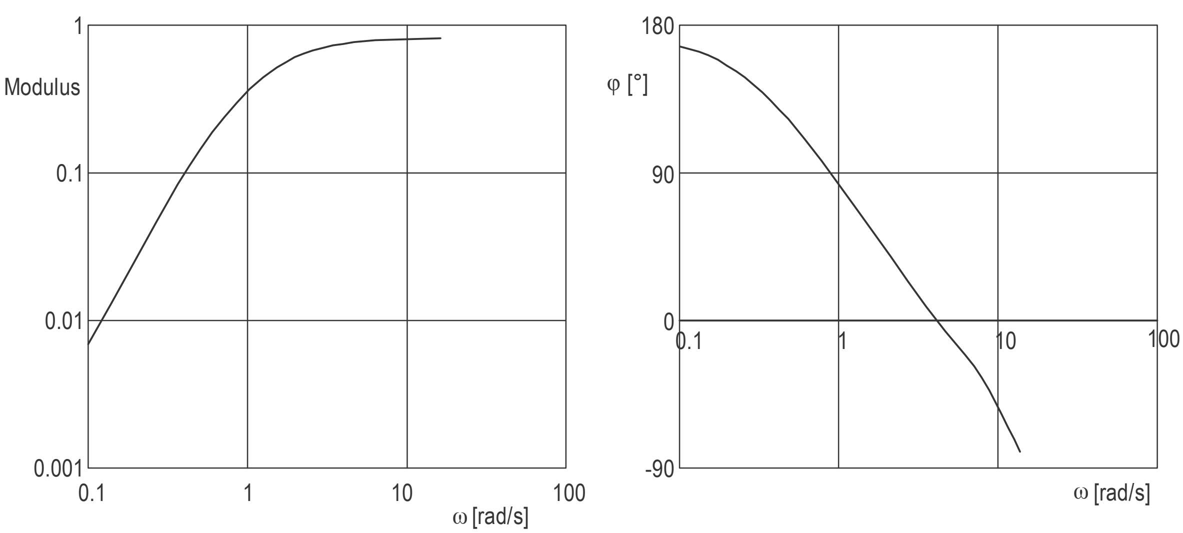


Figure B-7. Example bode plots of the frequency response derived from OMCT measurements

3.5.3.2 Time-domain based objective motion cueing test

A time-domain based objective motion cueing test, which would complement the frequency-domain test in 3.5.3.1, is currently being tested and evaluated by the TDWS (see Appendix D). This test will help quantify the response of the motion cueing system. The testing methodology, criteria and tolerances for this test will be implemented into this section after more testing and when sufficient experience is gained.

3.5.4 *Motion system repeatability*. The intent of this test is to ensure that the motion system software and motion system hardware have not degraded or changed over time. This will allow an improved ability to determine changes that have adversely affected the training value of the motion as was accepted during the initial qualification. The following information delineates the methodology that should be used for this test:

a) Conditions:

1) one test case on ground: to be determined by the FSTD operator; and

2) one test case in flight: to be determined by the FSTD operator.

b) Input. The inputs should be such that both rotational accelerations/rates and linear accelerations are inserted before the transfer from the aeroplane cg to the pilot reference point with a minimum amplitude of 5 $^\circ/s^2$, 10 $^\circ/s$ and 0.3 g, respectively, to provide adequate analysis of the output.

c) Recommended output:

1) actual platform linear accelerations; the output will comprise accelerations due to both the linear and rotational motion acceleration; and

2) motion actuators position.

3.5.5 *Motion vibrations*

3.5.5.1 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, for frequencies up to at least 20 Hz. 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, the algorithms used for the FSTD data should be proven to be sufficiently comparable. As a minimum, the results along the vertical and lateral axes should be presented. Longitudinal axis should be presented if either the aeroplane's or FSTD's vibrations are significant and, if the longitudinal axis is not presented, a rationale should be provided.

3.5.5.2 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 aeroplane data as per the following description; 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 1×10^{-3} $(g_{rms})^2$/Hz would describe a heavy buffet and may be seen in the deep stall regime. On the other hand, a 1×10^{-6} $(g_{rms})^2$/Hz buffet is almost not perceivable but may represent a flap buffet at low speed. The previous two examples 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.).

3.6 Visual system

3.6.1 *General*. Visual systems should be tested in accordance with the table of FSTD validation tests (see section 4).

3.6.2 *Visual ground segment*. See test 4.d.

a) Height 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 (centre line and G/S) of the aeroplane being simulated can be readily determined using approach/runway lighting and flight deck instruments.

b) The QTG should indicate the source of data, i.e. published decision height, aerodrome and runway used, ILS G/S antenna location (aerodrome and aeroplane), pilot's eye reference point, flight deck cut-off angle, etc., used to accurately make visual ground segment (VGS) scene content calculations (see Figure B-8).

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

3.6.3 *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.

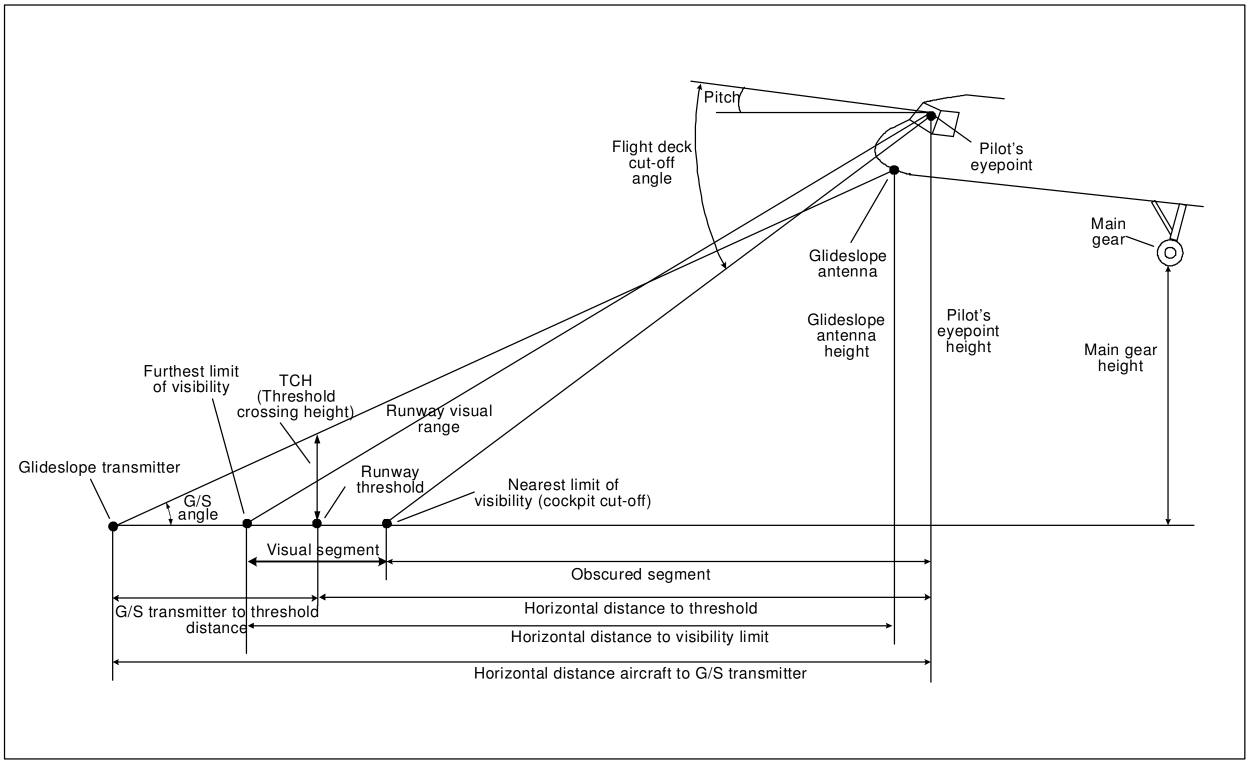


Figure B-8. VGS scene content calculations

3.6.3.1 Image position. See test 4.a.2.a.1.

3.6.3.1.1 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.

3.6.3.1.2 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 inches). Greater eye spacings should be accompanied by an explanation of any additional tolerance required.

3.6.3.2 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.

3.6.3.3 Image relative geometry. See test 4.a.2.a.3.

3.6.3.3.1 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.

3.6.3.3.2 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 minimized. 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.

3.6.3.3.3 The 200˚× 40˚ FOV is divided up into three zones to set tolerances for relative geometry as shown in Figure B-9.

3.6.3.3.4 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.

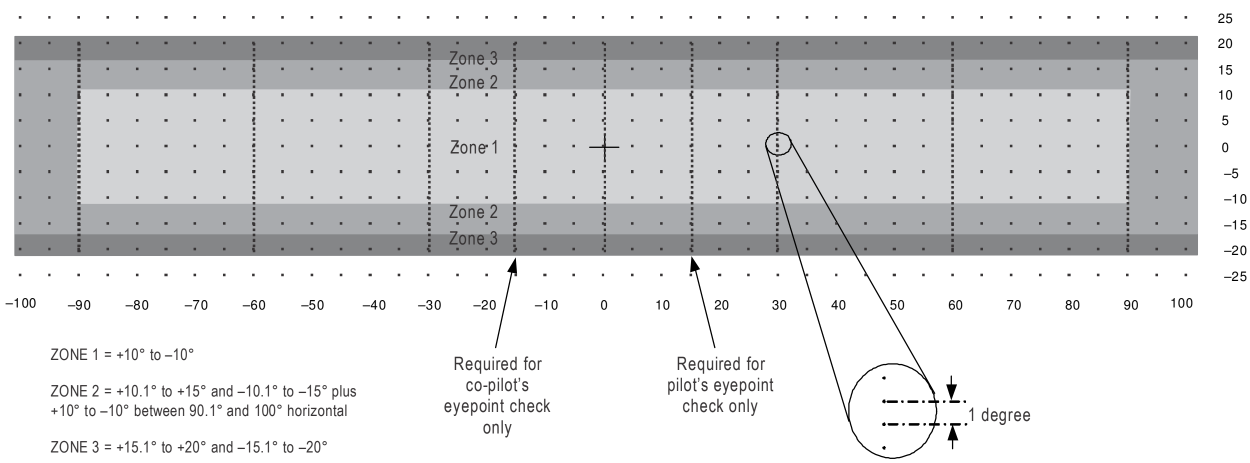


Figure B-9. Relative geometry test pattern showing zones.

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) where 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.

3.6.3.3.5 For recurrent testing, the use of an optical checking device is encouraged. This device should typically consist of a hand-held go/no go gauge to check that the relative positioning is maintained.

3.6.4 *Laser speckle contrast ratio (laser projection system).*

The objective measure of speckle contrast that is described in the following paragraphs 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.

3.6.4.1 Definition of speckle contrast ratio

3.6.4.1.1 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.

3.6.4.1.2 When applied to the intensity profile of an illuminated surface, the speckle contrast C is the RMS deviation normalized to the mean value.

3.6.4.1.3 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:

$$C = \frac{\sqrt{A \cdot \int_{FOV} (I(x,y))^2\, dA - \left(\int_{FOV} I(x,y) dA \right)^2}}{\int_{FOV} I(x,y) dA}$$

3.6.4.2 Speckle measurement

3.6.4.2.1 The intensity profile I(x, y) can be measured with a charge-coupled device (CCD) camera. The setup 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.

3.6.4.2.2 With the discrete nature of the CCD chip, I(x, y) translates into an array $I_{m,n}$, while

$$\frac{1}{A} \cdot \int_{FOV} I(x, y)\, dA$$

translates into:

$$\frac{1}{m \cdot n} \cdot \sum_{FOV} I_{m,n}$$

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

3.6.4.2.3 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.

3.6.4.2.4 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.

3.6.4.3 Speckle tolerance (see test 4.a.11)

If the speckle contrast is more than 10 per cent 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 per cent, the resolution and focus are not affected.

3.6.5 *Solid-state illuminators*

3.6.5.1 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/m^2 (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/m^2 (5.8 ft-lamberts) light-point brightness.

3.6.5.2 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.

3.7 Sound system

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

3.7.2 *Alternate propulsion*. For FSTDs with multiple propulsion configurations, any condition listed in section 5 (Sound systems) of this appendix that is identified by the aeroplane manufacturer as significantly different, due to a change in propulsion system (engine or propeller), should be presented for evaluation as part of the QTG.

3.7.3 *Data and data collection system.*

3.7.3.1 Information provided to the FSTD manufacturer should comply with the current edition of the IATA document *Flight Simulator Design and Performance Data Requirements*. This information should contain calibration and frequency response data.

3.7.3.2 The system used to perform the tests listed in section 5 of this appendix, should meet or exceed the following standards:

a) ANSI S1.11-2004, as amended — *Specification for Octave, Half-Octave and Third Octave Band Filter Sets*; and

b) IEC 61094-4-1995, as amended — *Measurement microphones* — Frequency response of the microphone used to record the FSTD sounds should be at least as good as the one used to record the approved dataset sounds.

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

3.7.5 *Playback equipment*. It is recommended that playback equipment such as a laptop and headphones and recordings from the approved dataset be available during initial evaluations in order to enable subjective comparison between FSTD results and the approved data.

3.7.6 *Volume Level*. The FSTD is qualified at the full volume level, which corresponds to the actual volume level in the approved dataset. When full volume is not selected, an indication of abnormal setting should be provided to the instructor to prevent inadvertent operation at this setting.

3.7.7 *Background noise.*

3.7.7.1 Background noise includes the noise in the FSTD due to the FSTD's cooling and hydraulic systems that are 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.

3.7.7.2 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 (see Figure B-10):

a) 70 dB @ 50 Hz;

b) 55 dB @ 1 000 Hz; and

c) 30 dB @ 16 kHz.

These limits are for unweighted 1/3 octave band sound levels. Meeting these limits for background noise does not ensure an acceptable FSTD. Aeroplane sounds which fall below this limit require careful review and may require lower limits on the background noise.

3.7.7.3 The background noise measurement may be rerun at the recurrent evaluation as per 3.7.9. The tolerances to be applied are that recurrent 1/3 octave band amplitudes cannot differ by more than ±3 dB when compared to the initial results.

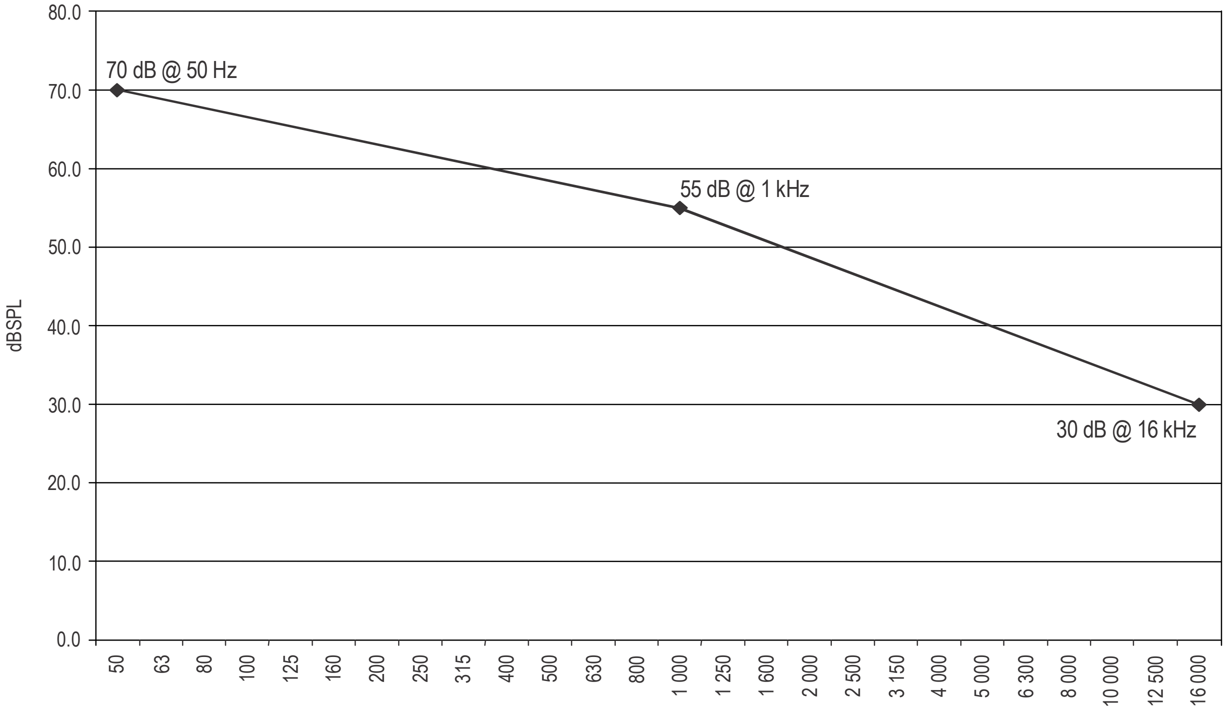


Figure B-10. 1/3 octave band frequency (Hz).

3.7.8 *Frequency response.* Frequency response plots for each channel should be provided at initial evaluation. These plots may be rerun at the recurrent evaluation as per 3.7.9. The tolerances to be applied are:

a) recurrent 1/3 octave band amplitudes cannot differ by more than ±5 dB for three consecutive bands when compared to the initial results; and

b) the average of the sum of the absolute differences between initial and recurrent results over all bands cannot exceed 2 dB (see Table B-2).

3.7.9 *Initial and recurrent evaluations*. If recurrent frequency response and FSTD background noise results are within tolerance, respective to initial evaluation results, and the FSTD operator can prove that no software or hardware changes have occurred that will affect the aeroplane cases, it is not required to rerun those cases during recurrent evaluations. If aeroplane cases are rerun during recurrent evaluations, the results may be compared against initial evaluation results rather than aeroplane master data.

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

a) variation of data between tail numbers;

b) frequency response of microphones;

c) repeatability of the measurements; and

d) extraneous sounds during recordings.

Note.— Atmospheric pressure differences between data collection and reproduction may play a role in subjective perceptions.

Table B-2. Example of recurrent frequency response test tolerance

Band centre frequency	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
1 000	79.2	80.1	0.9
1 250	80.7	82.8	2.1
1 600	81.6	78.6	3.0
2 000	76.2	74.4	1.8
2 500	79.5	80.7	1.2
3 150	80.1	77.1	3.0
4 000	78.9	78.6	0.3
5 000	80.1	77.1	3.0
6 300	80.7	80.4	0.3
8 000	84.3	85.5	1.2
10 000	81.3	79.8	1.5
12 500	80.7	80.1	0.6
16 000	71.1	71.1	0.0
		Average	1.1

4. TABLE OF FSTD VALIDATION TESTS

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.	PERFORMANCE										
1.a	**Taxi**										
1.a	(1) Minimum radius turn.	±0.9 m (3 ft) or ±20% of aeroplane turn radius.	Ground.					✓		✓	Plot both main and nose gear 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 of turn rate.	Ground.					✓		✓	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 certificated 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 crosswind take-off (1.b.6).*
1.b	(1) Ground acceleration time and distance.	±1.5 s or ±5% of time; and ±61 m (200 ft) or ±5% of distance.	Take-off.					✓		✓	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.
		For Type I, III and VI devices: ±1.5 s or ±5% of time.		✓		✓			✓		

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.b	(2) Minimum control speed, ground (V_{mcg}) using 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: ±2.2 daN (5 lbf) or ±10% of rudder pedal force.	Take-off.					✓		✓	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 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 V_{mcg} test is not available, an acceptable alternative is a flight test snap engine deceleration to idle at a speed between V_1 and V_1-10 kt, followed by control of heading using aerodynamic control only and recovery should be achieved with the main gear on the ground.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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.					✓		✓	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 seconds 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: ±2.2 daN (5 lbf) or ±10% of column force.	Take-off.					✓		✓	Data required for near maximum certificated take-off mass at mid centre of gravity location and light take-off mass at an aft centre of gravity location. If the aeroplane has more than one certificated take-off configuration, a different configuration should be used for each mass. 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.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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: ±2.2 daN (5 lbf) or ±10% of column force. ±1.3 daN (3 lbf) or ±10% of wheel force. ±2.2 daN (5 lbf) or ±10% of rudder pedal force.	Take-off.					✓		✓	Record take-off profile to at least 61 m (200 ft) AGL. Engine failure speed should be within ±3 kt of aeroplane data. Test at near MCTM.
1.b	(6) Crosswind take-off. (ctd next page)	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±6 m (20 ft) height. ±2° roll angle. ±2° sideslip angle. ±3° heading angle. Correct trends at ground speeds below 40 kt for rudder/pedal and heading angle.	Take-off.					✓		✓	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 10 m (33 ft) above the runway. Wind components should be provided as headwind and crosswind values with respect to the runway.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.b	(6) Crosswind take-off. (ctd)	For aeroplanes with reversible flight control systems: ±2.2 daN (5 lbf) or ±10% of column force. ±1.3 daN (3 lbf) or ±10% of wheel force. ±2.2 daN (5 lbf) or ±10% of rudder pedal force.									
1.b	(7) Rejected take-off.	±5% of time or ±1.5 s. ±7.5% of distance or ±76 m (250 ft).	Take-off.					✓		✓	Record at mass near MCTM. 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 full reverse, if applicable. Time and distance should be recorded from brake release to a full stop. For Type I, III and VI devices, record time for at least 80 % of the time segment from initiation of the rejected take-off to full stop.
		For Type I, III and VI devices: ±5% of time or ±1.5 s.		✓		✓			✓		

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.b	(8) Dynamic engine failure after take-off.	±2°/s or ±20% of body angular rates.	Take-off.					✓		✓	Engine failure speed should be within ±3 kt of aeroplane data. Engine failure may be a snap deceleration to idle. Record hands-off from 5 s before engine failure to +5 s or 30° roll angle, 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. ±0.5 m/s (100 ft/min) or ±5% of rate of climb.	Clean.	✓	C T & M	✓	C T & M	✓	✓	✓	Flight test data are preferred; however, aeroplane performance manual data are an acceptable alternative. Record at nominal climb speed and mid initial climb altitude. FSTD performance is to be recorded over an interval of at least 300 m (1 000 ft). For Type I, II, III, IV and VI devices, this test may be a snapshot test.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.c	(2) One-engine-inoperative 2nd segment climb.	±3 kt airspeed. ±0.5 m/s (100 ft/min) or ±5% of rate of climb, but not less than aeroplane performance data requirements.	2nd segment climb.	✓	C T & M	✓	C T & M	✓	✓	✓	Flight test data are preferred; however, aeroplane performance manual data are an acceptable alternative. Record at nominal climb speed. FSTD performance is to be recorded over an interval of at least 300 m (1 000 ft). Test at WAT (weight, altitude or temperature) limiting condition. For Type I, II, III, IV and VI devices, this test may be a snapshot test.
1.c	(3) One-engine-inoperative en-route climb.	±10% of time. ±10% of distance. ±10% of fuel used.	Clean.					✓		✓	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. ±0.5 m/s (100 ft/min) or ±5% rate of climb, but not less than aeroplane performance data requirements.	Approach.					✓		✓	Flight test data or aeroplane performance manual data may be used. FSTD performance to be recorded over an interval of at least 300 m (1 000 ft). Test near maximum certificated landing mass 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.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.d	**Cruise/Descent**										
1.d	(1) Level flight acceleration.	±5% of time.	Cruise.	✓		✓		✓	✓	✓	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 change.
1.d	(2) Level flight deceleration.	±5% of time.	Cruise.	✓		✓		✓	✓	✓	Time required to decrease airspeed 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 change.
1.d	(3) Cruise performance.	±.05 EPR or ±3% N_1 or ±5% of torque. ±5% of fuel flow.	Cruise.	✓		✓		✓	✓	✓	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. ±1.0 m/s (200 ft/min) or ±5% of rate of descent.	Clean.					✓		✓	Idle power stabilized 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. ±1.5 m/s (300 ft/min) or ±5% of rate of descent.	As per aeroplane performance data.					✓		✓	Stabilized descent to be conducted with speed brakes extended if applicable, at mid-altitude and near V_{mo} or according to emergency descent procedure. FSTD performance to be recorded over an interval of at least 900 m (3 000 ft).

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.e	**Stopping**										
1.e	(1) Deceleration time and distance, manual wheel brakes, dry runway, no reverse thrust.	±1.5 s or ±5% of time. For distances up to 1 220 m (4 000 ft), the smaller of ±61 m (200 ft) or ±10% of distance. For distances greater than 1 220 m (4 000 ft), ±5% of distance.	Landing.					✓		✓	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 certificated 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.	±1.5 s or ±5% of time; and the smaller of ±61 m (200 ft) or ±10% of distance.	Landing.					✓		✓	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 certificated landing mass. Engineering data may be used for the medium mass condition.
1.e	(3) Stopping distance, wheel brakes, wet runway.	±61 m (200 ft) or ±10% of distance.	Landing.					✓		✓	Either flight test or manufacturer's performance manual data should be used, where available. Engineering data, based on dry runway flight test stopping distance and the effects of contaminated runway braking coefficients, are an acceptable alternative.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.e	(4) Stopping distance, wheel brakes, icy runway.	±61 m (200 ft) or ±10% of distance.	Landing.					✓		✓	Either flight test or manufacturer's performance manual data should be used, where available. Engineering data, based on dry runway flight test stopping distance and the effects of contaminated runway braking coefficients, are an acceptable alternative.
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.					✓		✓	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. See paragraph 3.1 and Figure B-1 of this appendix.
		For Type I, III and VI devices: ±10% T_i or ±1 s; and ±10% T_t or ±1 s.		✓		✓			✓		
		For Type II and IV devices: ±10% T_i or ±1 s; and ±10% T_t or ±1 s.			CT&M		CT&M				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
1.f	(2) Deceleration.	±10% T_i or ±0.25 s; and ±10% T_t or ±0.25 s.	Ground.					✓		✓	T_i = total time from initial throttle movement until a critical engine parameter reaches 10% of its total response below maximum take-off power. T_t = 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. See paragraph 3.1 and Figure B-2 of this appendix.
		For Type I, III and VI devices: ±10% T_i or ±1 s; and ±10% T_t or ±1 s.		✓		✓			✓		
		For Type II and IV devices: ±10% T_i or ±1 s; and ±10% T_t or ±1 s.			CT&M		CT&M				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.	HANDLING QUALITIES										
2.a	**Static control checks**										
	Note 1.— Testing of position versus force is not applicable if forces are generated solely by use of aeroplane hardware in the FSTD. *Note 2.— 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 and/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 3.— 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.*										
2.a	(1) Pitch controller position versus force and surface position calibration.	±0.9 daN (2 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force. ±2° elevator angle.	Ground.	✓ PPL CPL		✓		✓	✓	✓	Uninterrupted control sweep to stops. Test results should be validated with in-flight data from tests such as longitudinal static stability, stalls, etc.
	Pitch controller position versus force.	±0.9 daN (2 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force.	Approach.	C T & M MPL1	C T & M		C T & M				Control forces and travel should broadly correspond to that of the class of aeroplane being simulated.
2.a	(2) Roll controller position versus force and surface position calibration.	±0.9 daN (2 lbf) breakout. ±1.3 daN (3 lbf) or ±10% of force. ±2° aileron angle. ±3° spoiler angle.	Ground.	✓ PPL CPL		✓		✓	✓	✓	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 lbf) breakout. ±1.3 daN (3 lbf) or ±10% of force.	Approach.	C T & M MPL1	C T & M		C T & M				Control forces and travel should broadly correspond to that of the class of aeroplane being simulated.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.a	(3) Rudder pedal position versus force and surface position calibration.	±2.2 daN (5 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force. ±2° rudder angle.	Ground.	✓ PPL CPL		✓		✓	✓	✓	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 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force.	Approach.	C T & M MPL1	C T & M		C T & M				Control forces and travel should broadly correspond to that of the class of aeroplane being simulated.
2.a	(4) Nosewheel steering controller force and position calibration.	±0.9 daN (2 lbf) breakout. ±1.3 daN (3 lbf) or ±10% of force.	Ground.	✓ PPL CPL C T & M MPL1		✓		✓	✓	✓	Uninterrupted control sweep to stops.
		±2° NWA.		✓		✓		✓	✓	✓	
2.a	(5) Rudder pedal steering calibration.	±2° NWA.	Ground.	✓		✓		✓	✓	✓	Uninterrupted control sweep to stops.
2.a	(6) Pitch trim versus surface position calibration.	±0.5° trim angle.	Ground.					✓		✓	The purpose of the test is to compare FSTD surface position indicator against the FSTD flight controls model computed value.
		±1.0° trim angle.		✓	C T & M	✓	C T & M		✓		
2.a	(7) Pitch trim rate.	±10% of trim rate (°/s) or ±0.1°/s trim rate.	Ground and approach.	✓		✓		✓	✓	✓	Trim rate to be checked at pilot primary induced trim rate (ground) and autopilot or pilot primary trim rate in-flight at go-around flight conditions. For CCA, representative flight test conditions should be used.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.a	(8) Alignment of cockpit throttle lever versus selected engine parameter.	When matching engine parameters: ±5° of TLA. When matching detents: ±3% N_1 or ±.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.	✓	C T & M	✓	C T & M	✓	✓	✓	Simultaneous recording for all engines. The tolerances apply against 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 are acceptable, provided 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.
2.a	(9) Brake pedal position versus force and brake system pressure calibration	±2.2 daN (5 lbf) or ±10% of force. ±1.0 MPa (150 psi) or ±10% of brake system pressure.	Ground.					✓		✓	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.
		For Type I, III and VI devices: ±2.2 daN (5 lbf) or ±10% of force.		✓ CPL PPL C T & M MPL1		✓			✓		

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.a	(10) Stick pusher system force calibration	±10% or 2.2 daN (5 lbf) stick/column force	Ground or flight.							✓	Aeroplane manufacturer design data should be utilized as validation data as determined acceptable by the CAA. Test requirement should be met through column force validation testing in conjunction with test 2.c.8a (stall characteristics). Test is intended to validate the stick/column transient forces as a result of a stick pusher system activation to prevent an aerodynamic stall. If flight conditions are not available, this test should be conducted in an on-ground condition through stimulation of the stall protection system in a manner that generates a stick pusher response that is exemplar of an in-flight condition. If a condition exemplar of an in-flight condition is infeasible, a ground condition is acceptable. *Note.— See Attachment P, 2.1 for a definition of "exemplar".*

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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. See paragraph 3.2 of this appendix.										
2.b	(1) Pitch control. (ctd next page)	For **underdamped systems** (as per Figure B-3 of this appendix): 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) ±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) ±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.	Take-off, cruise and landing.					✓		✓	Data should be for normal control displacements in both directions (approximately 25% to 50% of 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. See paragraphs 3.2.2, 3.2.3, 3.2.4 and 3.2.5 of this appendix. For overdamped and critically damped systems, see Figure B-4 of this appendix for an illustration of the reference measurement.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.b	(1) Pitch control (ctd)	*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: $T(P_0)$ ±10% of P_0 or ±0.05 s.						✓		✓	
2.b	(2) Roll control.	Same as 2.b.1.	Take-off, cruise and landing.					✓		✓	Data should be for normal control displacement (approximately 25% to 50% of full throw or approximately 25% to 50% of maximum allowable roll controller deflection for flight conditions limited by the manoeuvring load envelope). See paragraphs 3.2.2, 3.2.3, 3.2.4 and 3.2.5 of this appendix.
2.b	(3) Yaw control.	Same as 2.b.1.	Take-off, cruise and landing.					✓		✓	Data should be for normal control displacement (approximately 25% to 50% of full throw). See paragraphs 3.2.2, 3.2.3, 3.2.4 and 3.2.5 of this appendix.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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.					✓		✓	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.
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.					✓		✓	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 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.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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.					✓		✓	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.*
2.c	(1) Power change dynamics. **OR** for Type II and IV devices: (1) Power change force.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle. ±2.2 daN (5 lbf) or ±20% of pitch controller force.	Approach.	✓	C T & M C T & M	✓	C T & M C T & M	✓	✓	✓	Power change from thrust for approach or level flight to maximum continuous or go-around power. Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the power change to the completion of the power change +15 s. **CCA:** Test in normal and non-normal control mode for Type V and VII devices. For Type I, II, III, IV and VI devices, test in normal mode only. Force tests (Type II or IV devices) should provide the force required to maintain constant airspeed or altitude to complete the configuration change.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.c	(2) Flap change dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Take-off through initial flap retraction, and approach to landing.	✓	CT&M	✓	CT&M	✓	✓	✓	Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the configuration change to the completion of the configuration change +15 s. **CCA:** Test in normal and non-normal control mode for Type V and VII devices. For Type I, II, III, IV and VI devices, test in normal mode only. Force tests (type II or IV devices) should provide the force required to maintain constant airspeed or altitude to complete the configuration change.
	OR for Type II and IV devices: (2) Flap change force.	±2.2 daN (5 lbf) or ±20% of pitch controller force.			CT&M		CT&M				
2.c	(3) Spoiler/speedbrake change dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Cruise.	✓	CT&M	✓	CT&M	✓	✓	✓	Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the configuration change to the completion of the configuration change +15 s. Results required for both extension and retraction. **CCA:** Test in normal and non-normal control mode for Type V and VII devices. For Type I, II, III, IV and VI devices, test in normal mode only.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.c	(4) Gear change dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Take-off (retraction) and approach (extension).	✓	C T & M	✓	C T & M	✓	✓	✓	Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the configuration change to the completion of the configuration change +15 s. **CCA:** Test in normal and non-normal control mode for Type V and VII devices. For Type I, II, III, IV and VI devices, test in normal mode only.
	OR for Type II and IV devices: (4) Gear change force.	±2.2 daN (5 lbf) or ±20% of pitch controller force.			C T & M		C T & M				Force tests (Type II or IV devices) should provide the force required to maintain constant airspeed or altitude to complete the configuration change.
2.c	(5) Longitudinal trim.	±1° elevator angle. ±0.5° stabilizer angle. ±1° pitch angle. ±5% of net thrust or equivalent.	Cruise, approach and landing.					✓		✓	Steady-state wings level trim with thrust for level flight. This test may be a series of snapshot tests. **CCA:** Test in normal or non-normal control mode, as applicable.
		For Type I, III and VI devices: ±2° elevator angle. ±1° stabilizer angle. ±2° pitch angle. ±5% of net thrust or equivalent.		✓		✓			✓		Type I, III and VI devices may use pitch controller position instead of elevator angle and trim control position instead of stabilizer angle.
		For Type II and IV devices: ±2° elevator angle. ±1° stabilizer angle. ±2° pitch angle. ±5% of net thrust or equivalent.			C T & M		C T & M				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.c	(6) Longitudinal manoeuvring stability (stick force/g).	±2.2 daN (5 lbf) or ±10% of pitch controller force. Alternative method: ±1° or ±10% of the change of elevator angle.	Cruise, approach and landing.	✓ PPL CPL C T & M MPL1	C T & M	✓	C T & M	✓	✓	✓	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. Alternative method applies to aeroplanes which do not exhibit stick-force-per-g characteristics. For the alternative method, Type I, III and VI devices may use pitch controller position instead of elevator angle. **CCA:** Test in normal and non-normal control mode for Type V and VII devices. For Type I, II, III, IV and VI devices, test in normal mode only.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.c	(7) Longitudinal static stability.	±2.2 daN (5 lbf) or ±10% of pitch controller force. Alternative method: ±1° or ±10% of the change of elevator angle.	Approach.	✓ PPL CPL C T & M MPL1	C T & M	✓	C T & M	✓	✓	✓	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 is not applicable if forces are generated solely by the use of aeroplane hardware in the FSTD. Alternative method applies to aeroplanes which do not exhibit speed stability characteristics. For the alternative method, Type I, III and VI devices may use pitch controller position instead of elevator angle. **CCA:** Test in normal or non-normal control mode, as applicable.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.c (ctd next page)	(8a) Stall characteristics.	±3 kt airspeed for stall warning and stall speeds. ±2.0° angle of attack for buffet threshold of perception and initial buffet based on 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° roll angle. Stall warning up to stall: ±2.0° pitch angle; ±2.0° angle of attack; and correct trend and magnitude for lateral/directional body rates. For FSTDs with reversible flight control systems: ±10% or ±2.2 daN (5 lbf) stick/column force (prior to g-break only). For FSTDs of aeroplanes equipped with stick pusher systems: ±10% or ±2.2 daN (5 lbf) stick/column force applied throughout the time history to just prior to the stick pusher activation.	2nd segment climb, cruise (high altitude) and approach or landing.							✓	See Attachment P, 1.1 for applicability. The following stall entry methods should be demonstrated in at least one of the three required flight conditions: — stall entry at wings level (1 g); — stall entry in turning flight of at least 25° bank angle (accelerated stall); and — stall entry in a power-on condition (required only for turboprop aeroplanes). The required cruise condition should be conducted in a flaps-up (clean) configuration. 2nd segment climb and approach/landing conditions should be conducted at different flap settings. Record the stall warning signal and initial buffet, if applicable. Time history data should be recorded for full stall and recovery through normal flight. The stall warning signal should occur in the proper relation to buffet/stall. FSTDs of aeroplanes exhibiting a sudden pitch attitude change or "g-break" should demonstrate this characteristic. FSTDs of aeroplanes exhibiting a random roll-off and/or loss of roll control authority should demonstrate this characteristic. SOC required (see Attachments C and P), as applicable, for the stall break and recovery, aerodynamic modelling, stick pusher modelling, etc.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
	Additional Notes for 2.c.8a. “Approach to stall” tolerances apply up to the activation of the stall warning system or aerodynamic stall buffet, whichever occurs first. “Stall warning up to stall” tolerances apply from the activation of the stall warning system or aerodynamic stall buffet, whichever occurs first, to just prior to the stall break. “Stall break and recovery” applies from just prior to the stall break (pitch break, g-break, stick pusher activation or other indication of a full/aerodynamic stall) through recovery to normal flight. Due to the inherently unstable and non-repeatable behaviour of the stall manoeuvre, parameters from the stall break and recovery will only be subject to correct trend and magnitude tolerances for the purpose of continuing qualification evaluations. Buffet threshold of perception to be based on normal acceleration at the pilot seat of 0.03 g peak to peak above the background noise. 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 manufacturers have used 0.1 g peak to peak). Demonstrate correct trend in growth of buffet amplitude from buffet threshold of perception to critical angle of attack for Ny and Nz. The FSTD manufacturer may limit maximum buffet based on motion platform capability or limitations. Where approved engineering simulation validation is used, the reduced engineering tolerances (as defined in Attachment C) do not apply. Tests may be conducted at a centre of gravity typically required for aeroplane certification stall testing. Tolerances are applied to Nz, though correct trends are required for Nx and Ny, if relevant. **CCA:** Test in normal and non-normal control states. For CCA aeroplanes with stall envelope protection systems, tests are only required in non-normal control state if acceptable angle of attack envelope protection tests are provided (see test 2.h (flight and manoeuvre envelope protection functions)).										
2.c (ctd next page)	(8b) Approach to stall characteristics.	±3 kt airspeed for stall warning speeds. ±2° roll angle for speeds greater than stick shaker or initial buffet. For aeroplanes with reversible flight control systems: ±10% or ±2.2 daN (5 lbf) of column force (prior to g-break only).	2nd segment climb and approach or landing.					✓			Wings-level (1 g) stall entry with thrust at or near idle power. Time history data should be shown to first indication of stall and recovery. Stall warning signal should be recorded. **CCA:** Test in normal and non-normal control mode for Type V devices, as applicable. For Type I, II, III, IV and VI devices, test in normal mode only, as applicable.
		For Type I, II, III, IV and VI devices (the manoeuvre need not include full stall): ±3 kt airspeed for stall warning.		✓	CT&M	✓	CT&M		✓		

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
	Additional Notes for 2.c.8b. Source data and modelling methods: The SOC must identify the sources of data used to develop the aerodynamic model. Of particular interest is a mapping of test points in the form of 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. In cases where limited data is available to model and/or validate the stall characteristics (e.g. safety issues involving the collection flight test data), the data provider is expected to make a reasonable attempt to develop a stall model through analytical methods and utilization of the best available data.										
2.c	(9) Phugoid dynamics.	±10% of period. ±10% of time to one half or double amplitude or ±0.02 of damping ratio.	Cruise.					✓		✓	Test should include three full cycles or that necessary to determine time to one half or double amplitude, whichever is less. **CCA:** Test in non-normal control mode.
		For Type I, II, III, IV and VI devices: ±10% of period, with representative damping.		✓	CT&M	✓	CT&M		✓		
2.c	(10) Short period dynamics.	±1.5° pitch angle or ±2°/s pitch rate. ±0.1 g normal acceleration.	Cruise.					✓		✓	**CCA:** Test in normal and non-normal control mode.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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 landing (V_{mcl}), per applicable airworthiness requirement or low speed engine-inoperative handling characteristics in the air.	±3 kt airspeed.	Take-off or landing (whichever is most critical in the aeroplane).	C T & M	C T & M	C T & M	C T & M	✓	C T & M	✓	Minimum speed may be defined by a performance or control limit which prevents demonstration of V_{mca} 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. For Type I, II, III, IV and VI devices, it is important that there exists a realistic speed relationship between V_{mca} (or V_{mcl}) and V_s for all configurations and in particular the most critical full-power engine-out configuration. **CCA:** Test in normal or non-normal control state, as applicable.
2.d	(2) Roll response (rate).	±2°/s or ±10% of roll rate.	Cruise and approach or landing.	✓	C T & M	✓	C T & M	✓	✓	✓	Test with normal roll control displacement (approximately one-third of maximum roll controller travel). This test may be combined with test 2.d.3 (step input of flight deck roll controller).
		For aeroplanes with reversible flight control systems: ±1.3 daN (3 lbf) or ±10% of wheel force.		✓ PPL CPL C T & M MPL1	C T & M	✓	C T & M	✓	✓	✓	

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.d	(3) Step input of flight deck roll controller.	±2° or ±10% of roll angle.	Approach or landing.	✓		✓		✓	✓	✓	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 test 2.d.2 (roll response (rate)). **CCA:** Test in normal and non-normal control mode for Type V and VII devices. For Type I, III and VI devices, test in normal mode only.
2.d	(4) Spiral stability.	Correct trend and ±2° or ±10% of roll angle in 20 s. If alternate test is used: correct trend and ±2° aileron angle.	Cruise and approach or landing.					✓		✓	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 mode.
		For Type I, II, III, IV and VI devices: Correct trend and ±3° or ±10% of roll angle in 20 s.		✓	C T & M	✓	C T & M		✓		
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.	✓		✓		✓	✓	✓	Test should be performed in a manner similar to that for which a pilot is trained to trim an engine failure condition. The 2nd segment climb test should be at take-off thrust. Approach or landing test should be at thrust for level flight. This test may consist of snapshot tests. For Type I, III and VI devices, sideslip angle is matched only for repeatability and only on continuing recurrent evaluations.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.d	(6) Rudder response.	±2°/s or ±10% of yaw rate. **OR** for Type II and IV devices: ±2°/s or ±10% of yaw rate or ±10% of heading change.	Approach or landing.	✓	C T & M	✓	C T & M	✓	✓	✓	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 mode for Type V and VII devices. For Type I, II, III, IV and VI devices, test in normal mode only.
2.d	(7) Dutch roll.	±0.5 s or ±10% of period. ±10% of time to one half or double amplitude or ±.02 of damping ratio. ±1 s or ±20% of time difference between peaks of roll angle and sideslip angle.	Cruise and approach or landing.					✓		✓	Test for at least six cycles with stability augmentation off. **CCA:** Test in non-normal control mode.
		For Type I, III and VI devices: ±0.5 s or ±10% of period, with representative damping.		✓		✓			✓		

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.d	(8) Steady state sideslip.	For a given rudder position: ±2° roll angle; ±1° sideslip angle; ±2° or ±10% of aileron angle; and ±5° or ±10% of spoiler or equivalent roll controller position or force.	Approach or landing.	✓	C T & M	✓	C T & M	✓	✓	✓	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 maximum allowable rudder. For Type I, III and VI devices, 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 lbf) or ±10% of wheel force. ±2.2 daN (5 lbf) or ±10% of rudder pedal force.		✓ PPL CPL C T & M MPL1	C T & M	✓	C T & M	✓	✓	✓	
2.e	**Landings**										
2.e	(1) Normal 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: ±2.2 daN (5 lbf) or ±10% of column force.	Landing.					✓		✓	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 certificated landing mass, the other at light or medium mass. **CCA:** Test in normal and non-normal control mode, as applicable.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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: ±2.2 daN (5 lbf) or ±10% of column force.	Minimum certificated landing flap configuration.					✓		✓	Test from a minimum of 61 m (200 ft) AGL to nosewheel touchdown. Test at near maximum certificated landing mass.
2.e	(3) Crosswind landing.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±3 m (10 ft) or ±10% of height. ±2° roll angle. ±2° sideslip angle. ±3° heading angle. For aeroplanes with reversible flight control systems: ±2.2 daN (5 lbf) or ±10% of column force. ±1.3 daN (3 lbf) or ±10% of wheel force. ±2.2 daN (5 lbf) or ±10% of rudder pedal force.	Landing.					✓		✓	Test from a minimum of 61 m (200 ft) AGL to a 50% decrease in main landing gear touchdown speed. It 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.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.e	(4) One-engine-inoperative landing.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±3 m (10 ft) or ±10% of height. ±2° roll angle. ±2° sideslip angle. ±3° heading angle.	Landing.					✓		✓	Test from a minimum of 61 m (200 ft) AGL to a 50% decrease in main landing gear touchdown speed.
2.e	(5) Autopilot landing (if applicable).	±1.5 m (5 ft) flare height. ±0.5 s or ±10% of T_f. ±0.7 m/s (140 ft/min) rate of descent at touchdown. ±3 m (10 ft) lateral deviation during roll-out.	Landing.					✓		✓	If the autopilot provides roll-out guidance, record lateral deviation from touchdown to a 50% decrease in main landing gear touchdown speed. Time of autopilot flare mode engagement to main gear touchdown should be noted. 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.					✓		✓	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° roll angle. ±2° sideslip angle.	As per aeroplane performance data.					✓		✓	Engine inoperative go-around required near maximum certificated landing mass with critical engine inoperative. Provide one test with autopilot (if applicable) and one without autopilot. **CCA:** Non-autopilot test to be conducted in non-normal mode.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.e	(8) Directional control (rudder effectiveness) with reverse thrust (symmetric).	±5 kt airspeed. ±2°/s yaw rate.	Landing.					✓		✓	Apply rudder pedal input in both directions using full reverse thrust until reaching full thrust reverser minimum operating speed.
2.e	(9) Directional control (rudder effectiveness) with reverse thrust (asymmetric).	±5 kt airspeed. ±3° heading angle.	Landing.					✓		✓	With full reverse thrust on the operating engine(s), maintain heading with rudder pedal input until maximum rudder pedal input or thrust reverser minimum operation speed is reached.
2.f	**Ground effect**										
2.f	(1) A test to demonstrate ground effect.	±1° elevator angle. ±0.5° stabilizer angle. ±5% of net thrust or equivalent. ±1° AOA. ±1.5 m (5 ft) or ±10% of height. ±3 kt airspeed. ±1° pitch angle.	Landing.					✓		✓	See paragraph 3.3.2 of this appendix. A rationale should be provided with justification of results. **CCA:** Test in normal or non-normal control mode, as applicable.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.g	**Wind shear**										
2.g	(1) A test to demonstrate wind shear models.	None.	Take-off and landing.					✓		✓	See Appendix A, 11.2 — Wind Shear.
2.h	**Flight and manoeuvre envelope protection functions**										*Note.— The requirements of 2.h are only applicable to computer-controlled aeroplanes. Time history results of response to control inputs during entry into each envelope protection function (i.e. with normal and degraded control states if function is different) are required. Set thrust as required to reach the envelope protection function.*
2.h	(1) Overspeed.	±5 kt airspeed.	Cruise.					✓		✓	
2.h	(2) Minimum speed.	±3 kt airspeed.	Take-off, cruise and approach or landing.					✓		✓	
2.h	(3) Load factor.	±0.1 g normal acceleration.	Take-off and cruise.					✓		✓	
2.h	(4) Pitch angle.	±1.5° pitch angle.	Cruise and approach.					✓		✓	
2.h	(5) Roll angle.	±2° or ±10% of roll angle.	Approach.					✓		✓	
2.h	(6) Angle of attack.	±1.5° AOA.	2nd segment climb and approach or landing.					✓		✓	

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
2.i	**Engine and airframe icing effects**										
2.i	(1) Engine and airframe icing effects demonstration (aerodynamic stall).		Take-off or approach or landing (One flight condition — two tests (ice on and off)).							✓	Tests will be evaluated for representative effects on relevant aerodynamic parameters such as angle of attack, control inputs, and thrust/power settings. See additional notes below.

Additional notes for 2.i.1.

Plotted parameters should include:

— altitude;
— airspeed;
— normal acceleration;
— engine power;
— angle of attack;
— pitch attitude;
— roll angle;
— flight control inputs; and
— stall warning and stall buffet threshold of perception.

Time history of a full stall and initiation of the recovery. Tests are intended to demonstrate representative aerodynamic effects caused by in-flight ice accretion. Flight test validation data are not required.

Two tests are required to demonstrate engine and airframe icing effects. One test will demonstrate the FSTD's baseline performance without icing, and the second test will demonstrate the aerodynamic effects of ice accretion relative to the baseline test.

The test should utilize the icing model(s) as described in the required SOC in Appendix A, 2.1.S.e. The test should include a rationale that describes the icing effects being demonstrated. Icing effects should include, but are not limited to, the following effects as applicable to the particular aeroplane:

— decrease in stall angle of attack;
— changes in pitching moment;
— decrease in control effectiveness;
— changes in control forces;
— increase in drag;
— change in stall buffet characteristics and threshold of perception; and
— engine effects (power reduction/variation, vibration, etc.).

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
3.	MOTION SYSTEM										
3.a	**Frequency response.**	As specified by the applicant for FSTD qualification.	Not applicable.						✓	✓	Appropriate test to demonstrate required frequency response. See paragraph 3.5.2 of this appendix.
	Leg balance.	Not applicable.									Not applicable.
3.b	**Turn-around check.**	As specified by the applicant for FSTD qualification.	Not applicable.						✓	✓	Appropriate test to demonstrate required smooth turn-around. See paragraph 3.5.2 of this appendix.
3.c	**Motion effects.**										See Appendix C
3.d	**Motion system repeatability.**	±0.05 g actual platform linear accelerations.	None.						✓	✓	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 paragraph 3.5.4 of this appendix.
3.e	(1) Motion cueing fidelity — Frequency-domain criterion.	See Attachment F.	Ground and flight.							✓	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 aeroplane being simulated. This test is only required during the initial FSTD qualification or if changes are made to the motion drive algorithms. See paragraph 3.5.3 of this appendix.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
3.e	(2) Motion cueing fidelity — Time-domain criterion.	TBD.	Ground and flight.							✓	Appropriate testing criterion and tolerances are currently being tested and evaluated through the mechanism described in Appendix D.
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 for the aeroplane type.										The recorded test results for characteristic buffets should allow the comparison of relative amplitude versus frequency. See also paragraph 3.5.5 of this appendix. For Type VI devices, footprint test results are required.
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 of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Ground.						✓	✓	The test should be conducted at maximum possible thrust with brakes set.
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 of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Flight.						✓	✓	The 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 of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Flight.						✓	✓	The test condition should be at a normal operational speed and not at the flap limiting speed.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
3.f.	(4) Speedbrake deployed buffet.	The FSTD test results should exhibit the overall appearance and trends of the aeroplane data, with at least three of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Flight.						✓	✓	The test condition should be at a typical speed for a representative buffet.
3.f.	(5) Stall buffet.	The FSTD test results should exhibit the overall appearance and trends of the aeroplane data, with at least three of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Cruise (high altitude), and approach or landing.						✓	✓	Tests should be conducted for approach to stall at angles of attack between the initial buffet and the critical angle of attack. Post stall characteristics are not required. If stabilized flight data between initial buffet and stall speed are not available, PSD analysis should be conducted for the time span between initial buffet and stall speed. *Note.— The test is not required if the aeroplane does not exhibit buffet before reaching the critical angle of attack.*
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 of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Flight.						✓	✓	The 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 of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Flight in clean configuration.						✓	✓	The test should be conducted to be representative of in-flight vibrations for propeller-driven aeroplanes.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
4.	VISUAL SYSTEM										
4.a	**Visual scene quality**										
4.a.1	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.	Not applicable.						✓	✓	Field of view should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares. Installed alignment should be confirmed in an SOC (this would generally consist of results from acceptance testing).
	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.	Not applicable.	✓ PPL CPL		✓		✓			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).
	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.	Not applicable.	✓ MPL1	✓		✓				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.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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°.	Not applicable.						✓	✓	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-degree grid should fall within 3° of the design position as measured from each pilot eyepoint.	Not applicable.						✓	✓	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.	Not applicable.						✓	✓	For a diagram showing zones 1, 2 and 3 and further discussion of this test, see paragraph 3.6.3.3 of this appendix. *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.		✓	✓	✓	✓	✓			

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
4.a.3	Surface resolution (object detection).	Not greater than 2 arc minutes.	Not applicable.						✓	✓	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 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.		✓ PPL CPL		✓		✓			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.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
4.a.4	Light-point size.	Not greater than 5 arc minutes	Not applicable.						✓	✓	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.		✓ PPL CPL		✓		✓			

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
4.a.5	Raster surface contrast ratio.	Not less than 5:1.	Not applicable.	✓ PPL CPL		✓		✓	✓	✓	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/m^2 (2 ft-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.*

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
4.a.6	Light-point contrast ratio.	Not less than 25:1.	Not applicable.						✓	✓	Light-point contrast ratio should be measured using a test pattern demonstrating an area of greater than 1° area filled with white light points 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.		✓ PPL CPL		✓		✓			
4.a.7	Light-point brightness.	Not less than 20 cd/m^2 (5.8 ft-lamberts).	Not applicable.	✓ PPL CPL		✓		✓	✓	✓	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, see paragraph 3.6.5 of this appendix. On **raster systems** the light points should overlap such that the square is continuous (individual light points will not be visible).

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
4.a.8	Surface brightness.	Not less than 20 cd/m^2 (5.8 ft-lamberts) on the display.	Not applicable.						✓	✓	Surface brightness should be measured on a white raster, measuring the brightness using the 1° spot photometer. Light points are not acceptable. Use of calligraphic capabilities to enhance raster brightness is acceptable.
		Not less than 14 cd/m^2 (4.1 ft-lamberts) on the display.		✓ PPL CPL		✓		✓			
4.a.9	Black level and sequential contrast.	Black intensity: Background brightness — Black polygon brightness < 0.015 cd/m^2 (0.004 ft-lamberts). Sequential contrast: Maximum brightness — (Background brightness — Black polygon brightness) > 2 000:1.	Not applicable.						✓	✓	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 flight deck 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.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
4.a.10	Motion blur.	When a pattern is rotated about the eyepoint at 10˚/s, the smallest detectable gap should be 4 arc minutes or less.	Not applicable.						✓	✓	A test pattern consists of an array of 5 peak white squares with black gaps between them of decreasing width. The range of black gap widths should at least extend above and below the required detectable gap, and be in steps of 1 arc minutes. 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 CAA 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%.	Not applicable.						✓	✓	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.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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 minutes.	Not applicable.						✓	✓	Alignment requirement applies to any HUD system in use or both simultaneously if they are used simultaneously for training.
						✓		✓			Alignment requirement only applies to the pilot flying.
4.b.2	System display.	All functionality in all flight modes should be demonstrated.				✓		✓	✓	✓	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 aircraft instruments.	Flight.			✓		✓	✓	✓	For Type III and V devices, 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 out-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).						✓	✓	*Note.— The effects of the alignment tolerance in 4.b.1 should be taken into account.*
						✓		✓			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 (1200 ft) and 1609 m (1 sm) RVR including correct light intensity.	Flight.			✓		✓	✓	✓	Infra-red scene representative of both 350 m (1 200 ft), and 1 609 m (1 sm) RVR. Visual scene may be removed.
4.c.3	Thermal crossover.	Demonstrate thermal crossover effects during day to night transition.	Day and night.			✓		✓	✓	✓	The scene will correctly represent the thermal characteristics of the scene during a day to night transition.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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 an RVR setting of 300 m (1 000 ft) or 350 m (1 200 ft).			✓		✓	✓	✓	This test is designed to assess items impacting the accuracy of the visual scene presented to a pilot at DH on an ILS approach. These items include: — RVR/visibility; — glide slope (G/S) and localizer modelling accuracy (location and slope) for an ILS; — for a given mass, configuration and speed representative of a point within the aeroplane's operational envelope for a normal approach and landing; and — radio altimeter. If a generic aeroplane is used as the basic model, a generic cut-off angle of 15˚ is assumed as an ideal. *Note.— If non-homogeneous fog is used, the vertical variation in horizontal visibility should be described and included in the slant range visibility calculation used in the VGS computation.*

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
4.e	**Visual system capacity**										
4.e.1	System capacity — Day mode.	Not less than: 10 000 visible textured surfaces, 6 000 light points, 16 moving models.	Not applicable.	✓ PPL CPL		✓		✓	✓	✓	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.	✓ PPL CPL		✓		✓	✓	✓	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. *Note.— These are the requirements for Type I used for MPL 1 or Type II, or Type IV devices when a reduced FOV is not utilized.*
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.	✓ MPL1	✓		✓				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. Applies to Type I and IV devices when used to support MPL1 and MPL2 training and to Type II devices when used to support IR training, applications allowing the use of a reduced FOV visual system.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.	SOUND SYSTEMS										
5.a	**Turbo-jet/Turbo-fan aeroplanes**										All Type V to VII device tests in this section should be presented using an unweighted 1/3 octave band format from at least bands 17 to 42 (50 Hz to 16 kHz). A measurement of minimum 20 s should be taken at the location corresponding to the approved dataset. The approved dataset and FSTD results should be produced using comparable data analysis techniques. See paragraph 3.7 of this appendix. For Type IV devices, tests in this section may be presented as a single overall SPL level.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
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.							✓	Normal condition prior to engine start. The APU should be on if appropriate. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.a	(2) All engines at idle.	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.							✓	Normal condition prior to take-off. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.a	(3) All engines at maximum allowable thrust with brakes set.	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.							✓	Normal condition prior to take-off. This test is intended to check the maximum stabilized allowable thrust with brakes set, without jeopardizing the aeroplane and safety. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.a	(4) Climb.	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.	En-route climb.							✓	Medium altitude. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.a	(5) Cruise.	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.	Cruise.							✓	Normal cruise configuration. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.a	(6) Speed brake/spoilers extended (as appropriate).	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.	Cruise.							✓	Normal and constant speed brake deflection for descent at a constant airspeed and power setting. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.a	(7) Initial approach.	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.	Approach.							✓	Constant airspeed, gear up, flaps/slats as appropriate. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.a	(8) Final approach.	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.	Landing.							✓	Constant airspeed, gear down, landing configuration flaps. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.b	**Propeller-driven aeroplanes**										All Type V to VII device tests in this section should be presented using an unweighted 1/3 octave band format from at least bands 17 to 42 (50 Hz to 16 kHz). A measurement of minimum 20 s should be taken at the location corresponding to the approved dataset. The approved dataset and FSTD results should be produced using comparable data analysis techniques. See paragraph 3.7 of this appendix. For Type IV devices, tests in this section may be presented as a single overall SPL level.

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.b	(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.							✓	Normal condition prior to engine start. The APU should be on if appropriate. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.b	(2) All propellers feathered, if applicable.	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.							✓	Normal condition prior to take-off. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.b	(3) Ground idle or equivalent.	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.							✓	Normal condition prior to take-off. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.b	(4) Flight idle or equivalent.	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.							✓	Normal condition prior to take-off. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.b	(5) All engines at maximum allowable power with brakes set.	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.							✓	Normal condition prior to take-off. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.b	(6) Climb.	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.	En-route climb.							✓	Medium altitude. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.b	(7) Cruise	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.	Cruise.							✓	Normal cruise configuration. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.b	(8) Initial approach.	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.	Approach.							✓	Constant airspeed, gear up, flaps extended as appropriate, RPM as per operating manual. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.b	(9) Final approach.	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.	Landing.							✓	Constant airspeed, gear down, landing configuration flaps, RPM as per operating manual. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.c	**Special cases**	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.								✓	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. For Type VII devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For Type VII devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations. For Type V to VII devices, tests in this section should be presented using an unweighted 1/3 octave band format from at least bands 17 to 42 (50 Hz to 16 kHz). A measurement of minimum 20 s should be taken at the location corresponding to the approved dataset. The approved dataset and FSTD results should be produced using comparable data analysis techniques. See paragraph 3.7 of this appendix. For Type IV devices, tests in this section may be presented as a single overall SPL level.
		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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
5.d	**FSTD background noise**	Initial evaluation: background noise levels should fall below the plot in Figure B-10 of this appendix. Recurrent evaluation: ±3 dB per 1/3 octave band compared to initial evaluation.						✓	✓	✓	Results of the background noise at initial qualification should be included in the QTG document and approved by the qualifying CAA. The simulated sound will be evaluated to ensure that the background noise does not interfere with training. See paragraph 3.7.7 of this appendix. The measurements are to be made with the simulation running, the sound muted and a dead cockpit. For Type V to VII devices, this test should be presented using an unweighted 1/3 octave band format from band 17 to 42 (50 Hz to 16 kHz). For Type IV devices, this test may be presented as a single overall SPL level.
		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 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 (static with all systems switched off).					✓	✓	✓	Only required if the results are to be used during recurrent evaluations according to paragraph 3.7.8 of this appendix. The results should be acknowledged by the CAA during the initial qualification. For Type V to VII devices, this test should be presented using an unweighted 1/3 octave band format from band 17 to 42 (50 Hz to 16 kHz). For Type IV devices, 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.					✓				

	Test	Tolerance	Flight Condition	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Comments
6.	SYSTEM INTEGRATION										
6.a	**System response time**										
	(1) Transport delay.	Motion system response: 100 ms or less after controller movement (Type VII device). Instruments system response: 100 ms or less after controller movement. Visual system response: 120 ms or less after controller movement.	Pitch, roll and yaw.					✓		✓	A separate test is required in each axis. Where EFVS systems are installed, the EFVS 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 30 ms tolerance before comparison with visual system reference as described in Attachment G.*
		200 ms or less after controller movement.		✓	✓	✓	✓		✓		

Appendix C

FUNCTIONS AND SUBJECTIVE TESTS

1. INTRODUCTION

1.1 Accurate replication of aeroplane systems functions should be checked at each flight crew member position. This includes procedures using the AFM and checklists. Handling qualities, performance and FSTD systems operation as they pertain to the actual aeroplane, as well as FSTD cueing (e.g. visual cueing and motion cueing) and other supporting systems (e.g. IOS), should be subjectively assessed. Prior coordination with the CAA responsible for the evaluation is essential to ensure that the functions tests are conducted in an efficient and timely manner and that any skills, experience or expertise required by the evaluation team are available.

1.2 The necessity of functions and subjective tests arises from the need to confirm that the simulation has produced a totally integrated and acceptable replication of the aeroplane. Unlike the objective tests listed in Appendix B, subjective testing should cover areas of the flight envelope that may reasonably be reached by a trainee. Like the validation tests, the functions 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 FSTD operator should have 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 CAA evaluator(s).

1.3 At the request of an FSTD operator, the FSTD may be assessed for a special aspect of a relevant training programme during the functions and subjective portion of an evaluation. Such an assessment may include a portion of a line-oriented flight training (LOFT) scenario or special emphasis items in the training programme. Unless directly related to a requirement for the current qualification level, the results of such an evaluation would not affect the FSTD's current qualification status.

1.4 Functions tests should be run in a logical flight sequence at the same time as performance and handling assessments. This also permits the FSTD to run for two to three hours in real time, without repositioning of flight or position freeze, thereby permitting proof of reliability. A useful source of guidance for conducting the functions and subjective tests is published in the RAeS *Aeroplane Flight Simulator Evaluation Handbook*, Volume II (see Chapter 2, 2.3).

1.5 The FSTD should be assessed to ensure that repositions, resets and freezes support efficient and effective training.

1.6 At the time of writing, simulated ATC environment was still in the early stages of its development and adoption. As a result, training approval and device qualification for this subject has not yet been proven by experience. Until such a time, it is envisaged that the evaluation of FSTD simulated ATC environment capability will be conducted via training approval and not as part of FSTD qualification.

1.7 The FSTD should be assessed to ensure that simulated ATC environment supports the specific training task (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 high fidelity synthetic representation of real-world operations.

1.8 Since the requirements for simulated ATC environment are intentionally non-prescriptive, assessment will be largely subjective. The qualification of the FSTD should not be withheld, restricted or simulated ATC environment annotated as a "non-qualified task" as a result of non-compliance. However, if the system does not meet the criteria of a largely subjective evaluation, the training task should not be approved.

1.9 Further guidance on approval and qualification will be published in subsequent updates or amendments to this document when sufficient experience has been gathered by industry.

2. TEST REQUIREMENTS

2.1 The ground and flight tests and other checks required for qualification are listed in the following Table of Functions and Subjective Tests. The table includes manoeuvres and procedures (both conventional and performance-based navigation) to ensure that the FSTD functions and performs appropriately for use in pilot training and testing or checking in the manoeuvres and procedures normally required of an approved training programme.

2.2 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.

2.3 A representative selection of 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 ensure appropriate attention to system checks.

3. TABLE OF FUNCTIONS AND SUBJECTIVE TESTS

Note.— "Other" means any other test as applicable to the aeroplane being simulated and as applicable to the FSTD type.

Number	Functions and Subjective Tests	Type						
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**
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 that of the aeroplane being simulated.					✓		✓
1.a.2	The flight deck design and functions represent those of the simulated class of aeroplanes.	✓		✓			✓	
1.a.3	The flight deck design and functions are aeroplane-like and generic but recognizable as within a class of aeroplanes.		✓		✓			
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	Normal, automatic and alternate/emergency operation.	✓	✓	✓	✓	✓	✓	✓
2.c.2	Brake fade.					✓	✓	✓
2.d	**Other.**							
3	**TAKE-OFF.** *Note.— Only those take-off tests relevant to the type or class of the 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.	✓	✓	✓	✓	✓	✓	✓

Number	Functions and Subjective Tests	Type						
		I	II	III	IV	V	VI	VII
3.a.3	Crosswind (maximum demonstrated).	✓	✓	✓	✓	✓	✓	✓
3.a.4	**Special performance.**							
3.a.4.a	Reduced V_1.			✓	✓	✓	✓	✓
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.	✓		✓		✓	✓	✓
3.a.4.e	Obstacle (performance over visual obstacle).	✓		✓		✓	✓	✓
3.a.5	Low visibility take-off.		✓	✓	✓	✓	✓	✓
3.a.6	Landing gear, wing flap and leading edge device operation.	✓	✓	✓	✓	✓	✓	✓
3.a.7	Contaminated runway operations.	✓		✓		✓	✓	✓
3.a.8	Other.							
3.b	**Abnormal/emergency.**							
3.b.1	Rejected take-off.	✓	✓	✓	✓	✓	✓	✓
3.b.2	Rejected special performance take-off (e.g. reduced V1, maximum engine de-rate, soft field, short field/short take-off and landing (STOL) operations, etc.).	✓		✓		✓	✓	✓
3.b.3	Rejected take-off with contaminated runway.	✓		✓		✓	✓	✓
3.b.4	Continued take-off with failure of most critical engine at most critical point.			✓	✓	✓	✓	✓
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 engine(s) 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 V_{mo} or M_{mo}).			✓	✓	✓	✓	✓
5.a.6	High-IAS handling.			✓	✓	✓	✓	✓
5.a.7	Other.							

Number	Functions and Subjective Tests	Type						
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**
5.b	**Manoeuvres.**							
5.b.1.a	High angle of attack, approach to stall, stall warning, buffet and g-break (take-off, cruise, approach and landing configuration).	✓	✓	✓	✓	✓	✓	
5.b.1.b	High angle of attack, approach to stall, stall warning, buffet, g-break/pitch break and stick pusher response (take-off, cruise, approach and landing configuration). Aeroplane automation (such as autopilot and autothrottle) response to stall warning, stall and stick pusher.							✓
5.b.2	Slow flight.	✓		✓		✓	✓	✓
5.b.3	Upset recognition and recovery manoeuvres within the FSTD's validated envelope as defined on the statement of compliance (see Attachment P).							✓
5.b.4	Flight envelope protection (high angle of attack, bank limit, overspeed, etc.).			✓	✓	✓	✓	✓
5.b.5	Turns with/without speedbrake/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.			✓	✓	✓	✓	✓
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.14.c	Eights on pylons (visual resolution).	✓		✓		✓	✓	✓
5.b.14.d	Turns about a point.	✓		✓		✓	✓	✓
5.b.14.e	S-turns about a road or section line.	✓		✓		✓	✓	✓
5.b.15	Other.							
6	**DESCENT.**							
6.a	Normal.	✓	✓	✓	✓	✓	✓	✓
6.b	Maximum rate/emergency (clean, with speedbrakes, etc.).			✓	✓	✓	✓	✓
6.c	With autopilot.	✓	✓	✓	✓	✓	✓	✓
6.d	Flight control system failures, reconfiguration modes, manual reversion and associated handling.					✓		✓
6.e	Other.							

Number	Functions and Subjective Tests	Type						
		I	II	III	IV	V	VI	VII
7	**INSTRUMENT APPROACHES OPERATIONS.** *Note.— Only those instrument approach and landing tests relevant to the type or class of the aeroplane being simulated should be selected from the following list, where tests should be made with limiting wind velocities, wind shear (except for the CAT II and 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.		✓	✓	✓	✓	✓	✓
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 landing and roll-out (if applicable) guidance (manual and autoland).				✓	✓	✓	✓
7.a.3.b	Autopilot/autothrottle coupled approach to DH and go-around (manual and autopilot).				✓	✓	✓	✓
7.a.3.c	Autopilot/autothrottle coupled approach to land and roll-out (if applicable) guidance with one engine inoperative (manual and autoland).				✓	✓	✓	✓
7.a.3.d	Autopilot/autothrottle coupled approach to DH and go-around 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 maximum crosswind component demonstrated or authorized.				✓	✓	✓	✓
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.		✓	✓	✓	✓	✓	✓

Number	Functions and Subjective Tests	Type						
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**
7.b.3	VOR, VOR/DME, 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) — localizer performance (LP) and lateral navigation (LNAV) minima (at nominal and minimum authorized temperatures), all engine(s) operating and with one or more engine(s) inoperative.		✓	✓	✓	✓	✓	✓
7.b.5	ILS localizer only (LOC), and ILS localizer back course (LOC-BC) approaches (with and without CDFA), all engine(s) operating and with one or more engine(s) inoperative.		✓	✓	✓	✓	✓	✓
7.b.6	ILS offset localizer approach, all engine(s) operating and with one or more engine(s) inoperative.		✓	✓	✓	✓	✓	✓
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 engine(s) inoperative.	✓		✓	✓	✓	✓	✓
8.c	Operation of landing gear, flap/slats and speedbrakes (normal and abnormal).	✓		✓	✓	✓	✓	✓
8.d	Approach and landing with crosswind (maximum demonstrated crosswind component).	✓		✓	✓	✓	✓	✓
8.e	Approach and landing with flight control system failures (for reconfiguration modes, manual reversion and associated handling with the most significant degradation which is probable).					✓		✓
8.f	Approach and landing with standby (minimum) electrical/hydraulic power.				✓	✓	✓	✓
8.g	Approach and landing from circling conditions (circling approach). *Note.— For Types III, V, VI and VII, 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. For Type II and Type IV, 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.		✓	✓	✓	✓	✓	✓

Number	Functions and Subjective Tests	Type						
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**
8.j	Approach and landing from a precision approach.		✓	✓	✓	✓	✓	✓
8.k	Approach and landing from published visual approach (including those that use PBN)		✓	✓	✓	✓	✓	✓
8.l	Other.							
	Note.— An FSTD with a visual system, which permits 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 and anti-skid operation with dry conditions.		✓		✓			
10.a.6.d	Auto-braking system operation.			✓	✓	✓	✓	✓
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 engine systems operation (where fitted).**							
11.a.1	Air conditioning and pressurisation (Environmental Control System).			✓	✓	✓	✓	✓
11.a.2	De-icing/anti-icing.			✓	✓	✓	✓	✓
11.a.3	Auxiliary engine/auxiliary power unit (APU).			✓	✓	✓	✓	✓
11.a.4	Communications.	✓	✓	✓	✓	✓	✓	✓

Number	Functions and Subjective Tests	Type						
		I	II	III	IV	V	VI	VII
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.	✓	✓	✓	✓	✓	✓	✓
11.a.10	Pneumatic.	✓	✓	✓	✓	✓	✓	✓
11.a.11	Landing gear.	✓	✓	✓	✓	✓	✓	✓
11.a.12	Oxygen.			✓	✓	✓	✓	✓
11.a.13	Engine.	✓	✓	✓	✓	✓	✓	✓
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. 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 systems.	✓	✓	✓	✓	✓	✓	✓
11.a.20	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 and emergency procedures).					✓	✓	✓
11.a.27	Runway alerting and advisory system.					✓	✓	✓
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	**Wind shear:**							
11.b.3.a	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.	✓		✓		✓	✓	✓

Number	**Functions and Subjective Tests**	**Type**						
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**
12	**VISUAL SYSTEM.** This section is written in the context of the FSTD operator presenting models of real-world airports, serviced by the aeroplane type being simulated, for use in completion of the functions and subjective tests described in this appendix. 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 FSTD operator 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 CAA may select any visual scene used in the air operator's training programme(s) for completion of the functions and subjective tests, provided these visual scenes were modelled with the features required.							
12.a	**Functional test content requirements.** The following are the minimum airport model content requirements to satisfy visual capability tests, and provide suitable visual cues to allow completion of all functions and subjective tests described in this appendix. FSTD operators are encouraged to use the model content described below for the functions and subjective tests.							
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 real-world airport model to be consistent with published data used for aeroplane operations. This model should be acceptable to the FSTD operator's CAA and selectable from the IOS.	✓		✓				
12.a.1.c	A minimum of one generic airport model to be consistent with published data used for aeroplane operations. This model should be acceptable to the FSTD operator's CAA 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).	✓	✓	✓	✓	✓	✓	✓

Number	Functions and Subjective Tests	Type						
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**
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:** *Note.— The feature, if required, should be representative for Types I and III and generic for Types II and IV.*							
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.						✓	✓
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:** *Note.— The feature, if required, should be representative for Types I and III and generic for Types II and IV.*							
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.9	**Taxiway surface and markings (associated with each "in-use" runway) should include the following, if appropriate:** *Note.— The feature, if required, should be representative for Types I and III and generic for Types II and IV.*							
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 authorized in low visibility. The designated runway and taxi routing should be consistent with that airport for operations in low visibility.						✓	✓

Number	Functions and Subjective Tests	Type						
		I	II	III	IV	V	VI	VII
12.a.10	**Taxiway lighting of appropriate colours, directionality, behaviour and spacing (associated with each "in-use" runway) should include the following, if appropriate:** *Note.— The feature, if required, should be representative for Types I and III and generic for Types II and IV.*							
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 correlated with the displayed runway surface and lighting.						✓	✓
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.*	✓		✓		✓		

Number	Functions and Subjective Tests	Type						
		I	II	III	IV	V	VI	VII
12.a.14.c	Representative moving airborne traffic (including the capability to present air hazards, e.g. airborne traffic on a possible collision course).		✓		✓	✓	✓	✓
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.						✓	✓
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	Dynamic effects — the capability to present multiple ground and air hazards such as another aeroplane crossing the active runway or converging airborne traffic; hazards should be selectable via controls at the instructor station.		✓		✓	✓	✓	✓

Number	Functions and Subjective Tests	Type						
		I	II	III	IV	V	VI	VII
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.	PPL			✓	✓	✓	✓
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.	MPL1 CPL	✓	✓			✓	✓
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).			✓	✓	✓	✓	✓
12.e.5	The effect of rain removal devices should be provided.						✓	✓
12.f	**Scene quality.**							
12.f.1	**Quantization.**							
12.f.1.a	Surfaces and textural cues should be free from apparent quantization (aliasing).					✓	✓	✓
12.f.1.b	Surfaces and textural cues should not create distracting quantization (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.						✓	✓

Number	Functions and Subjective Tests	Type						
		I	II	III	IV	V	VI	VII
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. *Note.— RVR only required for Types V, VI and VII.*	✓	✓	✓	✓	✓	✓	✓
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.						✓	✓
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 recognize an event or situation. Where applicable below, the FSTD pitch, side loading and directional control characteristics, as well as the vibration 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 centre line lights, runway contamination with associated anti-skid and taxiway characteristics.						✓	✓
13.c	Buffets on the ground due to spoiler/speedbrake extension and thrust reversal.						✓	✓
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/speedbrake extension.						✓	✓
13.g	Buffet due to atmospheric disturbances.						✓	✓
13.h	Approach to stall buffet.						✓	✓
13.i	Touchdown cues for main and nose gear.						✓	✓
13.j	Nosewheel scuffing.						✓	✓
13.k	Thrust effect with brakes set.						✓	✓
13.l	Mach and manoeuvre buffet.						✓	✓

Number	**Functions and Subjective Tests**	**Type**						
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**
13.m	Tire failure dynamics.						✓	✓
13.n	Engine failures, malfunction, engine and airframe structural damage.						✓	✓
13.o	Tail, engine pod/propeller, wing strikes.						✓	✓
13.p	Other.							
14	**SOUND SYSTEM.**							
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/tire malfunctions, tail and engine pod/propeller strike and pressurization malfunctions.	✓	✓	✓	✓	✓	✓	✓
14.e	Sound of a crash when the FSTD is landed in excess of limitations.	✓	✓	✓	✓	✓	✓	✓
15	**SPECIAL EFFECTS.**							
15.a	Braking dynamics (normal and anti-skid, failure dynamics for brakes and anti-skid, reduced efficiency due to high temperature, etc.).						✓	✓
15.b	Effects of airframe and engine icing.		✓		✓	✓	✓	✓
16	**SIMULATED AIR TRAFFIC CONTROL (ATC) ENVIRONMENT.** *Note 1.— Automated simulation of standard ATC communications to the ownship is not mandated by this document, but is nevertheless strongly recommended. If the FSTD operator has elected to use the instructor to provide all ATC communications to the ownship, the evaluator will need to review the following functions list taking this into consideration.* *Note 2.— 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	Automated weather reporting.							
16.a.2.a	Multiple stations.						✓	✓
16.a.2.b	Single station.	✓	✓		✓	✓		
16.a.3	**Message format and regional characteristics.**							
16.a.3.a	Regional.						✓	✓
16.a.3.b	ICAO message format.	✓	✓		✓	✓	✓	✓
16.a.4	Provided by data link.						✓	✓

Number	Functions and Subjective Tests	Type						
		I	II	III	IV	V	VI	VII
16.b	**Other traffic.**							
16.b.1	**Aircraft behaviour.**							
16.b.1.a	Airport specific.						✓	✓
16.b.1.b	**Aircraft behaviour.**							
16.b.1.b.1	Appropriate routing.	✓	✓		✓	✓	✓	✓
16.b.1.b.2	Representative performance.	✓	✓		✓	✓	✓	✓
16.b.2	Airport clutter.						✓	✓
16.b.3	**Traffic flow and separation.**							
16.b.3.a	Scalable, if required.						✓	✓
16.b.3.b	Sufficient intensity, representative separation.	✓	✓		✓	✓	✓	✓
16.b.4	Traffic type (airport specific).						✓	✓
16.b.5	Traffic call sign and livery.	✓	✓		✓	✓	✓	✓
16.b.6	Runway incursion.						✓	✓
16.c	**Background radio traffic.**							
16.c.1	**Background radio traffic.**							
16.c.1.a	No obviously erroneous information.	✓	✓		✓	✓	✓	✓
16.c.1.b	Frequency specific messages.	✓	✓		✓	✓	✓	✓
16.c.1.c	No overstepping (normally).	✓	✓		✓	✓	✓	✓
16.c.1.d	Reasonable frequency access.	✓	✓		✓	✓	✓	✓
16.c.2	**Other traffic radio communications.**							
16.c.2.a	Intrusive, if required.						✓	✓
16.c.2.b	Non-intrusive.	✓	✓		✓	✓	✓	✓
16.c.3	**ATC radio communications**.							
16.c.3.a	Location-specific procedures and nomenclature.						✓	✓
16.c.3.b	**ATC radio communications.**							
16.c.3.b.1	Consistent with other traffic movements.	✓	✓		✓	✓	✓	✓
16.c.3.b.2	Continuous across sector boundaries.	✓	✓		✓	✓	✓	✓
16.c.3.b.3	ICAO standard phraseology (as per Doc 4444, PANS-ATM).	✓	✓		✓	✓	✓	✓
16.c.4	**Overstepping on frequency.**							
16.c.4.a	Basic ATC notification.	✓	✓		✓	✓	✓	✓
16.c.4.b	Indication at the IOS.	✓	✓		✓	✓	✓	✓
16.d	**Airport and airspace modelling.**							
16.d.1	**Simulated ATC environment modelled areas.**							
16.d.1.a	Minimum of one specific and two generic (or higher fidelity) airport models.						✓	✓
16.d.1.b	Minimum of two generic (or higher fidelity) airport models.	✓	✓		✓	✓	✓	✓

Number	Functions and Subjective Tests	Type						
		I	II	III	IV	V	VI	VII
16.d.2	**Runways.**							
16.d.2.a	Multiple.						✓	✓
16.d.2.b	Single.	✓	✓		✓	✓	✓	✓
16.d.3	Data synchronization.	✓	✓		✓	✓	✓	✓
16.e	**Weather.**							
16.e.1	Reference runway.	✓	✓		✓	✓	✓	✓
16.e.2	Other traffic separation.						✓	✓
16.e.3	Low visibility operations.						✓	✓
16.f	**ATC — ownship communications.**							
16.f.1	Time synchronization.	✓	✓		✓	✓	✓	✓
16.f.2	ATC radio communications.	✓	✓		✓	✓	✓	✓
16.f.3	**Message triggering.**							
16.f.3.a	Automatic.						✓	✓
16.f.3.b	Manual.	✓	✓		✓	✓		
16.f.4	“Standby” and “say again”.	✓	✓		✓	✓	✓	✓
16.f.5	Readback and acknowledgements.	✓	✓		✓	✓	✓	✓
16.f.6	Clearance deviations.						✓	✓
16.g	**Language and phraseology.**							
16.g.1	English.	✓	✓		✓	✓	✓	✓
16.g.2	Standard phraseology.	✓	✓		✓	✓	✓	✓
16.h	**Ownship radio operation.**							
16.h.1	Multi-frequency radio operation.	✓	✓		✓	✓	✓	✓
16.i	**System correlation.**							
16.i.1	Visual system.	✓	✓		✓	✓	✓	✓
16.i.2	TCAS.						✓	✓
16.i.3	Cockpit traffic displays, if installed.	✓	✓		✓	✓	✓	✓
16.i.4	IOS.	✓	✓		✓	✓	✓	✓
16.j	**Data link communications.**							
16.j.1	ATS clearances.						✓	✓
16.j.2	ATS weather.						✓	✓
16.j.3	DLIC.						✓	✓
16.j.4	Connection management.						✓	✓
16.j.5	CPDLC.						✓	✓
16.j.6	ADS-C.						✓	✓
16.j.7	AOC/DSP.						✓	✓
16.j.8	Service failures.						✓	✓

Number	Functions and Subjective Tests	Type						
		I	II	III	IV	V	VI	VII
16.k	**ATC voice characteristics.**							
16.k.1	**Voice assignment.**							
16.k.1.a	Multiple ATC voices.						✓	✓
16.k.1.b	Single ATC voice.	✓	✓		✓	✓		
16.k.2	Gender and accents.						✓	✓
16.l	**Instructor controls.**							
16.l.1	Access to radio communications.	✓	✓		✓	✓	✓	✓
16.l.2	Simulator functions.	✓	✓		✓	✓	✓	✓
16.l.3	Disable.	✓	✓		✓	✓	✓	✓
16.l.4	Mute (background radio traffic).	✓	✓		✓	✓	✓	✓
16.m	**Other.**							
17	**INSTRUCTOR OPERATING STATION.**							
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.**							
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.	✓	✓	✓	✓			

Number	Functions and Subjective Tests	Type						
		I	II	III	IV	V	VI	VII
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, cg, 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).	✓	✓	✓	✓	✓	✓	✓

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Appendix D

DOC 9625 UPDATE PROCESS

1. INTRODUCTION

Simulation technology and training research will continue to advance. It is likely that at some stage, before further revisions of Doc 9625 are published, other technical requirements or solutions to meet the criteria specified herein may be proposed. This appendix details the process to be undertaken when an update to this manual is considered.

2. PROCESS

2.1 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 CAA(s) concerned:

a) a detailed description of the technical proposal including differences and advantages compared with existing means of compliance for the criteria or requirement in question;

b) demonstration by the applicant to the satisfaction of the CAA that the proposed alternate 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;

c) revised or additional validation testing criteria to be used in FSTD evaluation and qualification;

d) revised or additional functional and subjective testing criteria to be used in FSTD evaluation and qualification; and

e) publication of supporting regulatory guidance documentation based on the technical proposal, the demonstration by the applicant, and the revised or additional criteria described above.

2.2 The items listed above are to be submitted to the International Pilot Training Consortium (IPTC) Training Devices Work Stream (TDWS). After establishing that the international training community supports the alternate requirements or solutions, the TDWS would prepare an update to Doc 9625.

3. FLOW CHART

Figure D-1 illustrates the process to be followed for an update to Doc 9625.

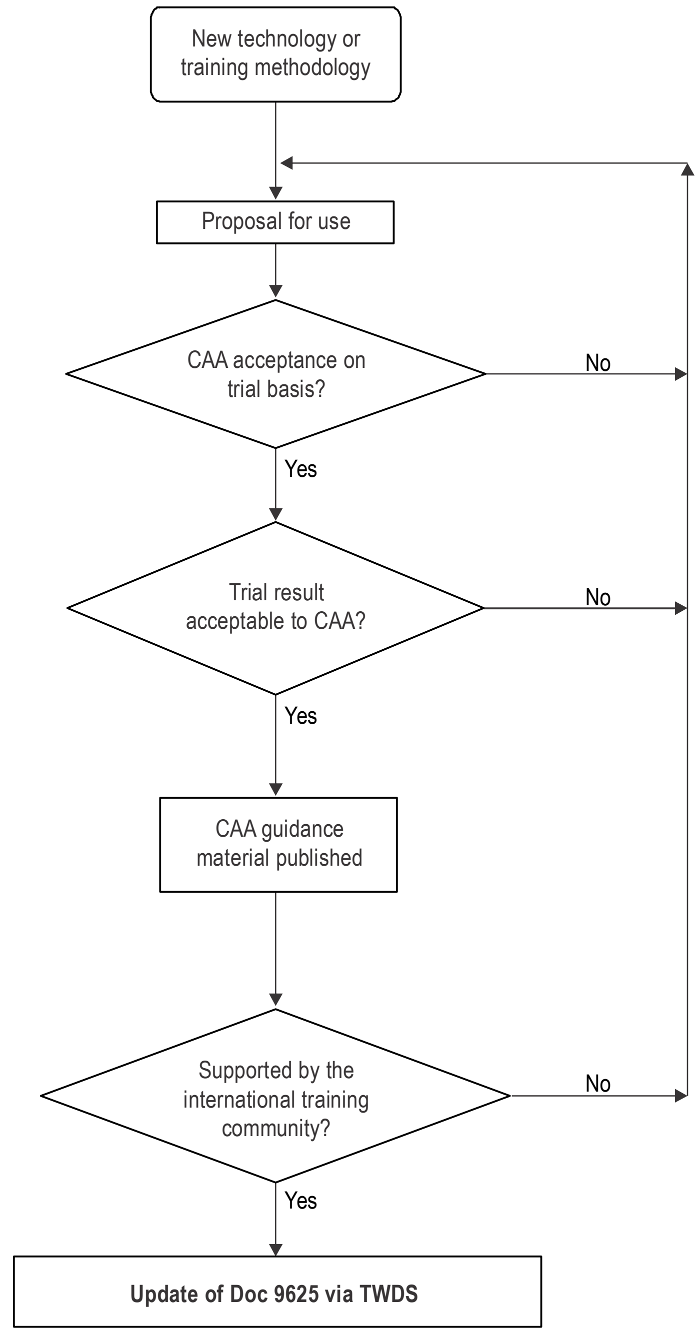

Figure D-1. Doc 9625 update process

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Attachment A

FSTD QUALIFICATION FOR NEW AEROPLANE TYPES

1.1 Aeroplane manufacturers' final approved data for performance, handling qualities, systems or avionics are usually not available until after a new or derivative aeroplane has entered service. In order to minimize the associated training risk, every effort should be made to provide the final data as soon as possible. However, it may be necessary to use preliminary data provided by the aeroplane manufacturer for interim qualification of FSTDs, so that flight crew training and licensing can begin several months prior to the entry of the first aeroplane into service. Flight crew training credit should be evaluated by the CAA, which may choose to impose a time limit or other limitations until final FSTD qualification has been granted.

1.2 In recognition of the sequence of events that should occur and the time required for final data to become available, the CAA may accept certain partially validated preliminary aeroplane and systems data, and early release ("red label") avionics data, in order to permit the necessary programme schedule for training, certification and service introduction.

1.3 FSTD qualification should be based upon approved data. FSTD operators seeking qualification based on preliminary data should, however, consult the CAA as soon as it is known that special arrangements will be necessary or as soon as it is clear that the preliminary data will need to be used for FSTD qualification. Aeroplane and FSTD manufacturers should also be made aware of the needs and be agreed parties to the data plan and FSTD qualification plan. The plans should include periodic meetings to keep the interested parties informed of project status.

1.4 The precise procedure followed to gain CAA acceptance of preliminary data will vary from case to case and among aeroplane manufacturers. Each aeroplane manufacturer's new aeroplane development and test programme is designed to suit the needs of the particular project and may not contain the same events or sequence of events as another manufacturer's programme or even the same manufacturer's programme for a different aeroplane. Hence, there cannot be a prescribed invariable procedure for acceptance of preliminary data, but instead a statement of needs with the final sequence of events, data sources and validation procedures agreed by the FSTD operator, the aeroplane manufacturer, the FSTD manufacturer and the CAA.

Note.— A description of aeroplane manufacturer-provided data needed for flight simulator modelling and validation is to be found in the IATA document Flight Simulation Training Device Design and Performance Data Requirements *(see Chapter 2, 2.3).*

1.5 There should be assurance that the preliminary data are the manufacturer's best representation of the aeroplane and reasonable certainty that final data will not deviate to a large degree from these preliminary projections, but will only be refined; they are not just estimates. Data derived from these predictive or preliminary techniques should be validated by available sources including, at least, the following:

a) Manufacturer's engineering report. Such a report should explain the predictive method used and illustrate past successes of the method on similar projects. For example, the manufacturer could show the application of the method to an earlier aeroplane model or predict the characteristics of an earlier model and compare the results to final data for that model.

b) Early flight test results. Such data will often be derived from aeroplane certification tests and should be used to maximum advantage for early FSTD qualification. Certain critical tests, which would normally be done early in the aeroplane certification programme, should be included to validate essential pilot training and certification manoeuvres. These include cases in which a pilot is expected to cope with an aeroplane failure mode including engine failures. The early data available, however, will depend on the aeroplane manufacturer's flight test programme design and may not be the same in each case. However, it is expected that the aeroplane manufacturer's flight test programme would include provisions for generation of very early flight test results for FSTD qualification.

1.6 The preliminary data supporting an interim qualification are not intended to be used for an indefinite period. The aeroplane manufacturer's final data should be made available within six months after the aeroplane's entry into service or as agreed by the CAA, the FSTD operator and the aeroplane manufacturer, but usually not later than one year after entry into service. In applying for an interim qualification using preliminary data, the FSTD operator and the CAA should agree upon the update programme. This will normally specify that the final data update will be installed in the FSTD within a period of six months following the final data release but not later than two years, unless special conditions exist and a different schedule is agreed.

1.7 FSTD avionics should essentially stay in step with aeroplane avionics (hardware and software) updates. The permitted time lapse between aeroplane and FSTD updates is not a fixed time but should be minimal. It may depend on the magnitude of the update and whether the QTG and pilot training and checking are affected. Permitted differences in aeroplane and FSTD avionics versions and the resulting effects on FSTD qualification should be agreed between the FSTD operator and the CAA. Consultation with the FSTD manufacturer is desirable throughout the agreement of the qualification process.

1.8 The following provides an example of the design data and sources which might be used in the development of an interim qualification plan.

1.8.1 The plan should consist of the development of a QTG based upon a mix of flight test and engineering simulation data. For data collected from specific aeroplane flight tests or other flights, the required design model/data changes necessary to support an acceptable proof of match (POM) should be generated by the aeroplane manufacturer.

1.8.2 In order to ensure that the two sets of data are properly validated, the aeroplane manufacturer should compare its simulation model responses against the flight test data when driven by the same control inputs and subjected to the same atmospheric conditions as recorded in the flight test. The model responses should result from a simulation where the following systems are run in an integrated fashion and are consistent with the design data released to the FSTD manufacturer:

a) propulsion;

b) aerodynamics;

c) mass properties;

d) flight controls;

e) stability augmentation; and

f) brakes/landing gear.

Note.— The POM should meet the relevant tolerances.

1.9 For the qualification of FSTDs of new aeroplane types, it may be beneficial that the services of a suitably qualified CAA or aeroplane manufacturer test pilot be used for the purpose of assessing handling qualities and evaluating performance.

Attachment B

ENGINEERING SIMULATION VALIDATION DATA

1. BACKGROUND

1.1 In the case of simulation models of a new or major derivative aeroplane that are fully flight test validated, it is likely that these models will become progressively unrepresentative as the aeroplane configuration is revised.

1.2 Traditionally, as the aeroplane configuration has been revised the simulation models have consequently 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 updated models and validation data.

1.3 The quality of the prediction of simulation models has advanced to the point where differences between predicted and flight test validated models are often quite small.

1.4 The major aeroplane manufacturers utilize the same simulation models in their engineering simulations as those released to the training community. These simulations vary from physical engineering simulators with and without aeroplane hardware to non-real-time workstation-based simulations.

2. APPROVAL GUIDELINES FOR USING ENGINEERING SIMULATION VALIDATION DATA

2.1 The current practice of requiring flight test data as a reference for validating training simulators should continue.

2.2 When a simulation model that is fully flight test validated is modified as a result of changes to the simulated aeroplane configuration, an aeroplane manufacturer may choose, with prior agreement of the CAA(s), to supply validation data from an engineering simulator/simulation to selectively supplement flight test data.

2.3 In cases where data from an engineering simulator are used, the appropriate CAA(s) is(are) responsible for auditing the engineering simulation process.

2.4 In all cases, a data package verified to current standards against flight tests should be available for the aeroplane "entry-into-service" configuration of the baseline aeroplane.

2.5 Where engineering simulation data are used as part of a QTG, a close match is expected as described in Attachment C.

2.6 In cases where the use of engineering simulation data is envisaged, a complete proposal should be presented to the appropriate CAA(s). Such a proposal would contain evidence of the engineering simulation data supplier's past achievements in high-fidelity modelling. The CAA(s) should conduct technical reviews of the proposed plan and of the subsequent validation data to establish acceptability of the proposal.

2.7 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.

2.8 A configuration management process should be maintained, including an audit trail which clearly defines the simulation model changes step-by-step, away from a fully flight-test validated simulation model, so that it would be possible to undo the changes and return to the baseline (flight-test validated) version.

2.9 The procedure will be considered complete when an approval statement is issued. This statement will identify acceptable validation data sources.

2.10 To be admissible as an alternative source of validation data, an engineering simulator should:

a) exist as a physical entity, complete with a flight deck, with controls sufficient for manual flight;

b) have a visual system and preferably also a motion system;

c) where appropriate, have actual avionics boxes interchangeable with the equivalent software simulations, to support validation of released software;

d) have a rigorous configuration control system covering hardware and software; and

e) have been found to be a high-fidelity representation of the aeroplane by the pilots of the manufacturers, air operators and the CAA(s).

2.11 Engineering simulators used to produce system data may not need all the above features.

2.12 The precise procedure followed to gain acceptance of engineering simulation data will vary from case to case depending on aeroplane manufacturers and type of change. Irrespective of the procedure followed, engineering simulations/simulators should conform to the following criteria:

a) the original (baseline) simulation models should have been fully flight test validated;

b) the models as released by the aeroplane manufacturer to the industry for the FSTD used in training should be essentially identical to those used by the aeroplane manufacturer in its engineering simulations/simulators; and

c) these engineering simulations/simulators will have been used as part of the aeroplane design, development or certification process.

2.13 FSTDs used for training and utilizing the baseline simulation models should be currently qualified to internationally recognized criteria such as those contained in this manual.

2.14 The types of modifications covered using engineering simulation validation data will be restricted to those with “well-understood effects”, such as:

a) software (e.g. flight control computer, autopilot);

b) simple (in aerodynamic terms) geometric revisions (e.g. fuselage length);

c) engines (limited to non-propeller-driven aeroplanes);

d) control system gearing/rigging/deflection limits; and

e) brake, tire and steering revisions.

2.15 The FSTD operator, with the assistance of the aeroplane manufacturer, wishing to take advantage of using engineering simulation validation data is expected to demonstrate a sound engineering basis for its proposed approach. Such analysis would show that the predicted effects of the change(s) were incremental in nature and both easily understood and well defined, confirming that additional flight test data were not required. In the event that the predicted effects were not deemed to be sufficiently accurate, it may be necessary to collect a limited set of flight test data to validate the predicted increments.

2.16 The CAA(s) should review any applications for this procedure and provide feedback.

Attachment C

VALIDATION TEST TOLERANCES

1. FLIGHT TEST TOLERANCES

1.1 The tolerances listed in Appendix B are designed to be a measure of quality of match using flight test data as a reference.

1.2 There are many reasons, however, why a particular test may not fully comply with the prescribed tolerances. For example:

a) flight test data are subject to many sources of potential error, e.g. instrumentation errors and atmospheric disturbance during data collection;

b) data that exhibit rapid variation or noise may also be difficult to match; and

c) engineering simulator data and other calculated data may exhibit errors due to the variety of potential differences listed in 1.6 below.

1.3 When applying tolerances to any test, good engineering judgment with reference to 1.6 below should be applied. Where a test clearly falls outside the prescribed tolerance(s) for no acceptable reason, it should be judged to have failed.

1.4 The use of non-flight test data as reference data was in the past quite infrequent. Thus, these tolerances were used for all tests. Over the last few years, the inclusion of this type of data as a validation source has rapidly expanded and will probably continue to expand.

1.5 When engineering simulation validation data are 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.

1.6 There are reasons why the results from an FSTD would differ from engineering validation test data. These reasons include, but are not limited to:

a) hardware (avionics and flight controls);

b) modelling solutions used in the FSTD different from those used by the aeroplane's original equipment manufacturer (ground handling models, braking models, engine models, etc.);

c) model cascading effects:

1) iteration rates;

2) execution order;

3) integration methods; and

4) processor architecture;

d) digital drift:

1) interpolation methods;

2) data handling differences; and

3) auto-test trim tolerances;

e) open loop versus closed loop responses, and test duration;

f) extent of dependency on contributory aeroplane systems adding to the complexity of the test; and

g) accuracy of the match of the initial conditions.

1.7 Any differences between FSTD results and engineering simulation validation data should, however, be small and the reasons for any differences, other than those listed in 1.6, should be clearly explained.

1.8 Historically, engineering simulation validation data were used only to demonstrate compliance with certain extra modelling features because:

a) flight test data could not reasonably be made available;

b) data from engineering simulations made up only a small portion of the overall validation dataset; and

c) key areas were validated against flight test data.

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

a) flight test data are often not available due to valid technical reasons;

b) alternative technical solutions are being advanced; and

c) cost is an ever-present consideration.

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

2. NON-FLIGHT TEST TOLERANCES

2.1 Where engineering simulation validation data or other non-flight test data are used as an allowable form of reference validation data for the objective tests listed in Appendix B, 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 (see section 1 above).

2.2 When non-flight test validation data are used for reference data, the tolerance applied should be 40 per cent of the corresponding flight test tolerances and out-of-tolerance flagging should be in accordance with this guideline. The validation data provider (aeroplane manufacturer) should supply a well-documented test procedure that enables replication of its engineering simulation results.

2.3 If the difference between the reference data and the FSTD results exceeds 40 per cent of the flight test tolerances, the FSTD manufacturer should provide a clear rationale for each affected QTG test case.

2.4 The validation data providers may identify cases where the suggested 40 per cent tolerance cannot be met. In such cases, the data providers should provide a clear rationale as part of their VDR (see Attachment D).

2.5 Where the engineering simulation used to generate reference data includes aeroplane hardware, the tolerances applied may have to be increased above the suggested 40 per cent. A rationale should be provided.

2.6 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.

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Attachment D

VALIDATION DATA ROADMAP

1.1 Aeroplane manufacturers or other sources of data should supply a validation data roadmap (VDR) document as part of the data package. A VDR document contains guidance material from the aeroplane validation data supplier recommending the best possible sources of data to be used as validation data in the QTG. A VDR is of special value in the cases of requests for interim qualification and requests for qualification of simulations of aeroplanes certificated prior to 1992, and for qualification of alternate engine or avionics fits (see Attachment E). A VDR should be submitted to the CAA as early as possible in the planning stages for any FSTD planned for qualification to the criteria contained herein. The respective CAA is the final authority to approve the data to be used as validation material for the QTG.

1.2 The VDR should clearly identify (in matrix format) sources of data for all required tests. It should also provide guidance regarding the validity of these data for a specific engine type and thrust rating configuration and the revision levels of all avionics affecting aeroplane handling qualities and performance. The document should include rationale or explanation in cases where data or parameters are missing, engineering simulation data are to be used, flight test methods require explanation, etc., together with a brief narrative describing the cause/effect of any deviation from data requirements. Additionally, the document should make reference to other appropriate sources of validation data (e.g. sound and vibration data documents).

1.3 Table D-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 Appendix B or to tests in the IATA document *Flight Simulation Training Device Design and Performance Data Requirements*. 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.

1.3.1 Include CCA mode column if applicable.

1.3.2 Include column for each validation source (e.g. each flight test airframe/engine combination and the simulation configuration).

1.3.3 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.

1.3.4 Data type numbering should align with the hierarchy of preferences outlined in Attachment J, 1.5.

1.4 Tables D-2 and D-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.

1.5 Additionally, two examples of “rationale pages” are presented in Appendix F of the IATA document *Flight Simulation Training Device Design and 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 to the CAA an acceptable basis for obtaining deviations from QTG validation requirements.

Table D-1. Validation data roadmap

ICAO/ IATA#	Test description	CCA mode *N — Normal law, D — Direct law*	Validation source: Aeroplane 1 flight test data	Validation source: Aeroplane 2 flight test data	Validation source: Engineering simulation data *(Aeroplane 2 with DEF-74 engines)*	Validation source: Aerodynamics POM	Validation document: Flight controls POM	Validation document: Ground handling POM	Validation document: Propulsion POM	Validation document: Integrated POM	Validation document: Aeroplane 2 Integrated validation data	Validation document: 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)*
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		

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.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 runway.	N	2		3	D73					d73		FT		
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 are 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 D-2. Recommended Qualification Test Guide — 1

QTG	Test description 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**	Validation source 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 cg.	N	B	B				X										
1.b (4)2	Normal take-off — Light weight — Mid cg.	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 D-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 groundspeed.

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	

Attachment E

GUIDELINES FOR ADDITIONAL/ALTERNATE ENGINES OR AVIONICS VALIDATION DATA

1. BACKGROUND

1.1 For a new aeroplane type, the majority of flight test validation data is collected on the first aeroplane configuration with a "baseline" engine fit and a "baseline" avionics configuration. Generally the flight test campaign is conducted on the first aeroplane with one engine fit, which forms the basis of the models and the data pack. This dataset is then used to validate all FSTDs representing that aeroplane type.

1.2 Primary engine fit is the FSTD terminology for the primary engine fit for the aeroplane configuration that the FSTD operator 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 2 of this attachment. Note that the FSTD operator's primary engine fit may not be the airframe manufacturer's baseline.

1.3 In the case of FSTDs representing an aeroplane with a different engine fit than the baseline, or with a revised avionics configuration or more than one avionics configuration, additional test validation data may be needed.

1.4 When an 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.

1.5 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 3 of this attachment.

1.6 The nature of the required complementary validation data (e.g. flight test data, engineering data) should be in accordance with the guidelines prescribed by paragraph 4 of this attachment, except where other data are specifically allowed (see Attachment B).

2. QTG GUIDELINES FOR THE QUALIFICATION OF ADDITIONAL ENGINE FITS

2.1 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 E-1 should be included in that subset, as a minimum.

2.2 When the additional engine fit is a different type from the primary configuration, all the tests under the additional engine type column in Table E-1 should be provided in the QTG.

2.3 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 five per cent or more, or is significantly less than the primary configuration engine rating (a decrease of fifteen per cent 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.

Table E-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	

3. QTG GUIDELINES FOR THE QUALIFICATION OF AN ALTERNATE AVIONICS CONFIGURATION

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

3.2 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.

3.3 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 FSTD operator should provide a statement from the aeroplane manufacturer clearly stating that this avionics change does not affect the test.

3.4 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 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 FSTD operator should provide a rationale from the aeroplane manufacturer explaining the nature of the change and its effect on the aeroplane response.

3.5 For an avionics change that significantly affects some tests in the QTG, especially where new functionality is added, the QTG should be based on validation data from the previously validated avionics configuration and supplemental avionics-specific 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 FSTD operator should coordinate FSTD data requirements in advance with the aeroplane manufacturer and then the CAA.

3.6 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.

4. VALIDATION DATA REQUIREMENT GUIDELINES FOR ALTERNATE ENGINE FITS AND ALTERNATE AVIONICS CONFIGURATIONS

4.1 For tests that are affected by difference in engine type or thrust rating as prescribed by paragraph 2, flight test data would be preferred to validate that particular aeroplane-engine configuration or the alternate thrust rating. Table E-2 presents a minimum list of validation tests that should be supported by flight test data.

4.2 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 E-2, as a minimum, should be supported by flight test data and presented in the QTG (along with additional tests listed in Table E-1 for which other sources of validation data are acceptable). Flight test data, other than throttle calibration and engine acceleration and deceleration data, are not required if the new thrust rating is certified on the aeroplane without need for a comprehensive stability and control flight instrumentation package.

4.3 Tests that are significantly affected by a change to the avionics configuration, as described in paragraph 3.5, should be supported by flight test data.

4.4 A matrix or VDR should be provided with the QTG indicating the appropriate validation data source for each test (see Attachment D). The FSTD operator should coordinate FSTD data requirements pertaining to alternate engines or avionics configurations in advance with the CAA.

Table E-2. Minimum recommended list of validation flight tests for an alternate engine configuration.

Test number	Test description		Alternate engine type	Alternate thrust rating[2]
1.b (1), (4)	Ground acceleration time and distance/normal take-off.		X	X
1.b (2)	Minimum control speed, ground (V_{mcg}), if performed for aeroplane certification.		X	X
1.b (5) 1.b (8)	Critical engine failure on take-off. Dynamic engine failure after take-off.	Either test may be performed.	X	
1.b (7)	Rejected take-off, if performed for aeroplane certification.		X	
1.d (3)	Cruise performance.		X	
1.f (1), (2)	Engine acceleration and deceleration[1].		X	X
2.a (8)	Alignment of cockpit throttle lever versus selected engine parameter (throttle calibration)[1].		X	X
2.c. (1)	Power change dynamics (acceleration).		X	X
2.d (1)	Minimum control speed, air (V_{mca}), if performed for aeroplane certification.		X	X
2.d (5)	Engine-inoperative trim.		X	X
2.e (1)	Normal landing.		X	

Note 1.— Should be provided for all changes in engine type or thrust rating (see 2.3).

Note 2.— See 2.3 for a definition of applicable thrust ratings.

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Attachment F

FREQUENCY-DOMAIN MOTION CUEING SYSTEM PERFORMANCE TEST

1. BACKGROUND

1.1 The objective of this attachment is to offer guidance on an objective test which should be used to ensure motion cueing of FSTDs is consistently delivered in an acceptable manner. This guidance should help engineers involved in preparing for this test as well as CAA personnel involved in the evaluation of FSTDs using this test.

1.2 The purpose of this test is to objectively measure the frequency response of the complete motion cueing system for specified degree-of-freedom 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.

1.3 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 a MDA is shown in Figure F-1.

1.4 In Figure F-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.

1.5 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.

1.6 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:

a) the motion cueing algorithm;

b) the motion platform actuator extension transformation and control laws;

c) the motion platform hardware that reacts to these transformed aeroplane motion commands; and

d) the digital time delay embedded in the above processes.

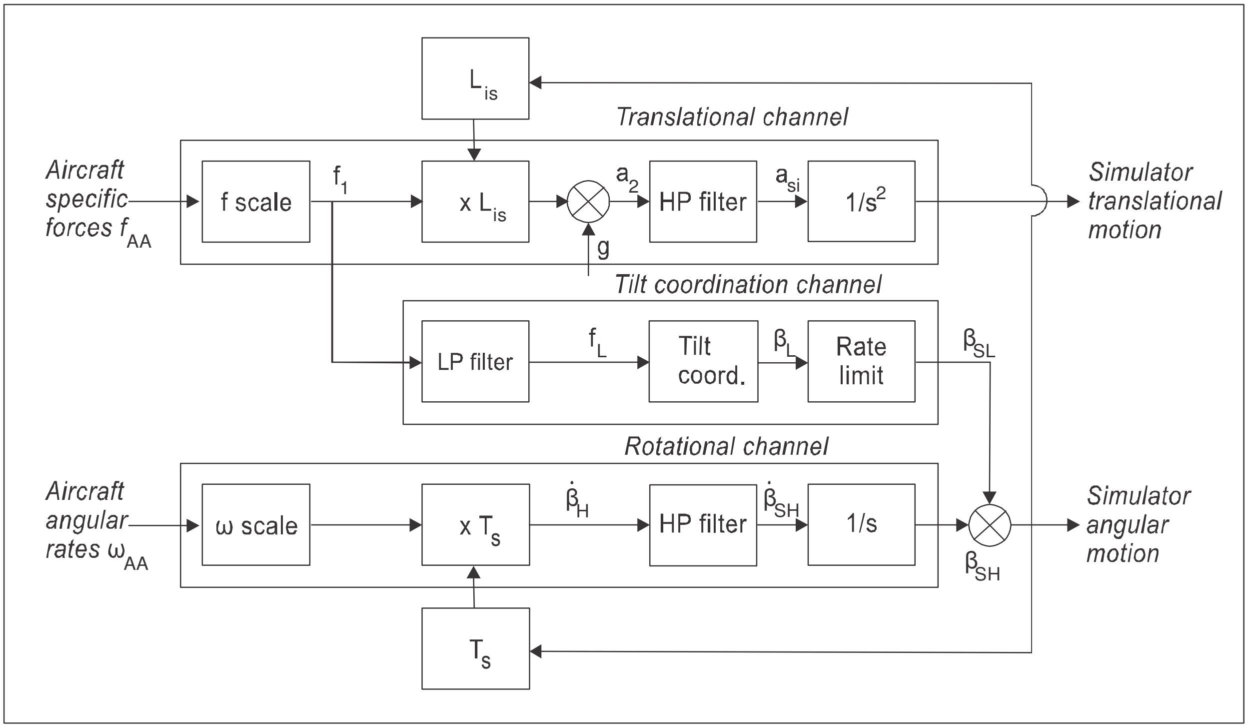

Figure F-1. Basic scheme of a motion cueing algorithm (from Reid-Nahon)

1.7 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.

1.8 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.

1.9 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 cg. It is important because this is what the pilot feels when in his 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 F-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 F-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 8.4.

1.10 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.

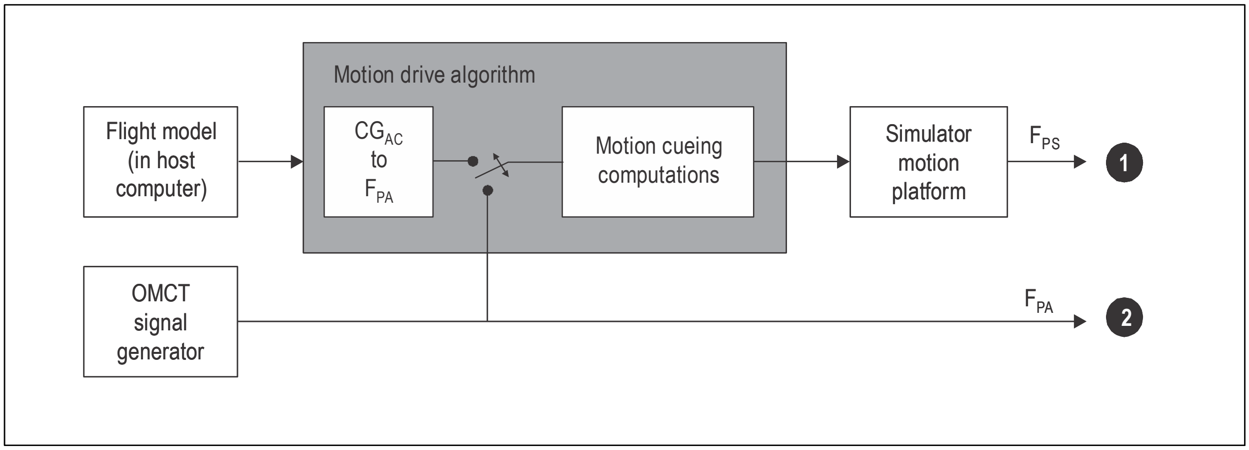

Figure F-2. Transformation from simulated aeroplane flight model output to motion platform response

1.11 The FSTD motion platform is defined as the mechanical hardware used to generate the motions.

1.12 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.

1.13 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:

a) FSTD rotational response due to aeroplane pure rotational manoeuvres;

b) FSTD specific force response due to aeroplane pure translational manoeuvres;

c) FSTD rotational accelerations due to aeroplane pure translational manoeuvres; and

d) FSTD translational response due to aeroplane pure rotational manoeuvres.

1.14 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 (c and d) provide information about the cross-coupling of the FSTD motion response and may be used to create the illusion of the aeroplane environment.

2. OBJECTIVE MOTION CUEING TEST (OMCT) PROCEDURE

2.1 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. If these settings are not changed between ground and flight on the FSTD in question, a single set of tests is acceptable.

2.2 *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 F-1.

Note.— In Table F-1, the frequency given in Hertz is that corresponding to the frequency in rad/s and is only shown for reference.

Table F-1. Input test signal frequencies and required modulus and phase measurements

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		

2.2.1 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 degree of freedom, 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.

2.2.2 During the OMCT, for the measurements required, the individual degrees of freedom 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 F-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 F-3) or by using appropriate digital methods.

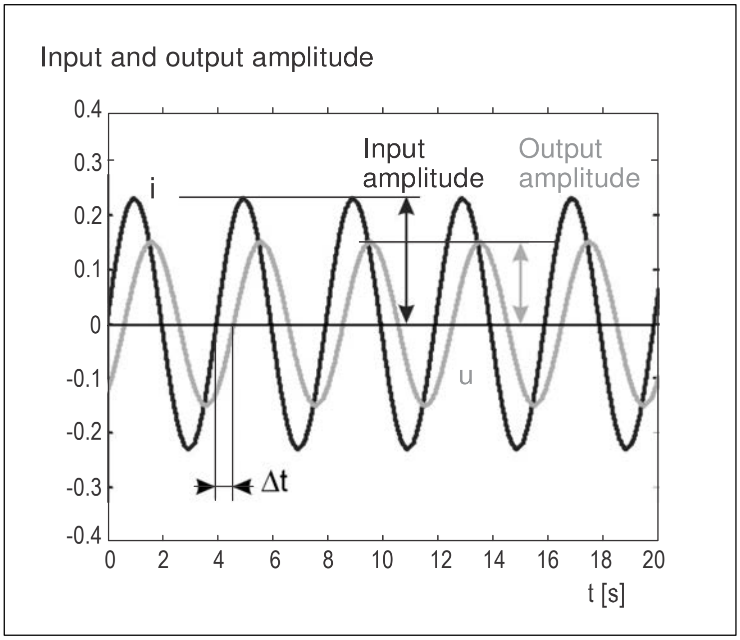

Figure F-3. General definition of amplitudes of an output signal *u* and input signal *i* and time shift *Δt* between *u* and *i*.

2.2.3 Whereas Table F-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.

2.2.4 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.

2.2.5 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 8.

3. INPUT AMPLITUDES

3.1 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.

3.2 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.

3.3 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 F-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.

3.3.1 *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 F-2:

$$f_{a/c}^{x,y,z}(t) = A \sin (\omega\ t).$$

3.3.2 *Rotational input amplitudes*. For the rotational inputs, the relations between attitude, angular rate and angular acceleration are given in Table F-3, and the corresponding amplitudes in Table F-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.

Table F-2. Specific force input amplitudes

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 F-3. Rotational 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 F-4. Rotational input amplitudes given by attitude, angular rate or acceleration

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
12	15.849	2.515 Hz	0.040	0.631	10.000

4. OMCT TEST 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 F-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.

5. OMCT TEST DESCRIPTION

5.1 The frequency responses describe the relations between aeroplane motions and FSTD motions as defined in Table F-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

5.2 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.

Table F-5. Test matrix with test numbers

	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

6. PRESENTATION OF RESULTS

6.1 The results should be presented for each of the OMCT tests defined in Table F-5, and at each frequency defined in Table F-1, in terms of the modulus and the phase. Ten tables should be presented as described in section 5 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 F-4). The modulus and phase tolerance boundaries for all ten tests are presented in Tables F-6 to F-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 6.2 below.

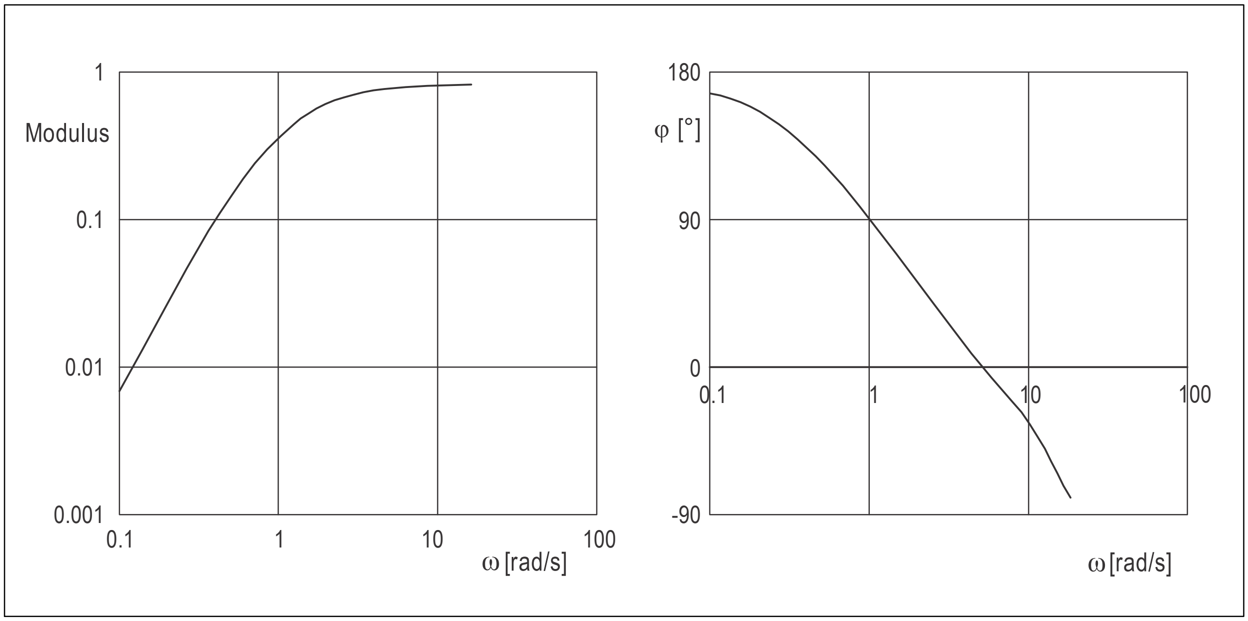

Figure F-4. Example of bode plots for the frequency response of a test of the motion cueing system.

6.2 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.

6.3 Regions of acceptable fidelity are given in Tables F-6 to F-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.

6.4 Tolerance tables for on-ground conditions have not yet been determined and will be provided in future revisions of this document.

6.5 From the above description of the OMCT, it is clear that the results describe the motion cueing system dynamic characteristics between F_{PA} and F_{PS} 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 F_{PA} is performed correctly.

7. MOTION CUEING CRITERIA

7.1 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 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 F-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.

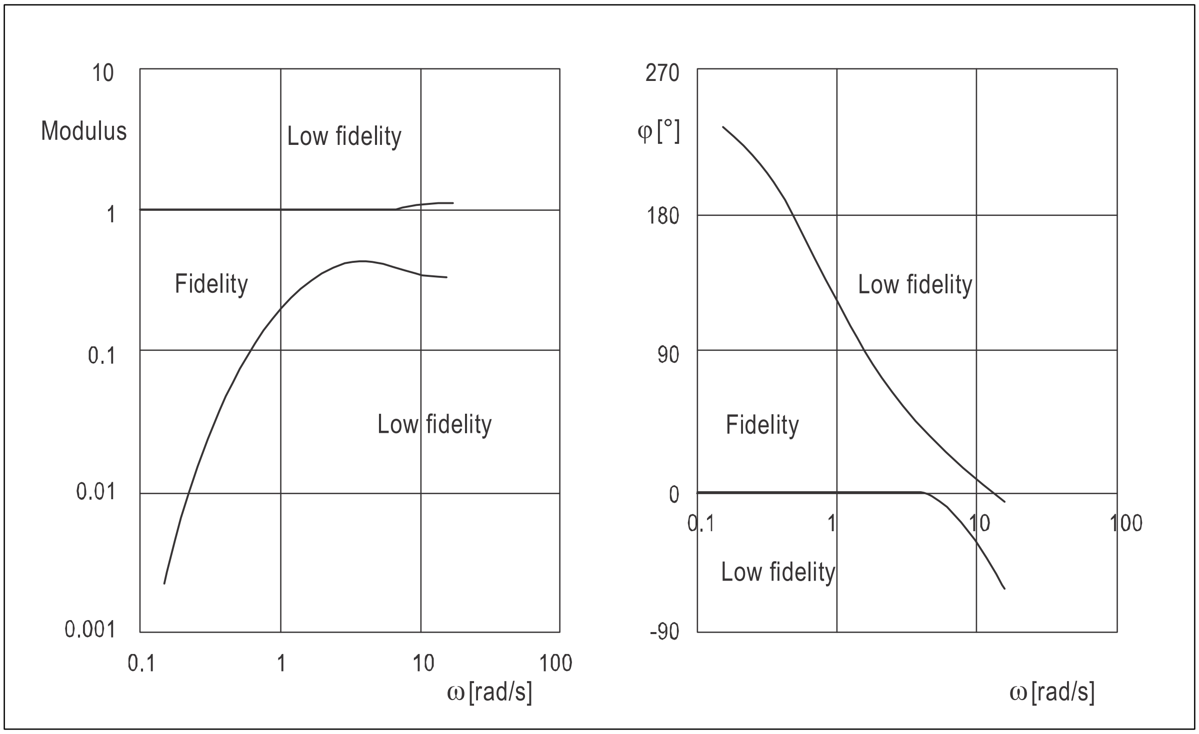

Figure F-5. Example of bode plots with the boundaries for the OMCT modulus and phase for fidelity.

7.2 In Tables F-6 to F-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.

Table F-6. The boundaries for fidelity for the modulus and phase of the frequency response for Test 1

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 F-7. The boundaries for fidelity for the modulus and phase of the frequency response for Test 2

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 F-8. The boundaries for fidelity for the modulus and phase of the frequency response for Test 3

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 F-9. The boundaries for fidelity for the modulus and phase of the frequency response for Test 4

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 F-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			
0.1585	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 F-11. The boundaries for fidelity for the modulus and phase of the frequency response for Test 6

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 F-12. The boundaries for fidelity for the modulus and phase of the frequency response for Test 7

	Modulus [° s^2/m]		Phase [°]	
Frequency [rad/s]	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

Table F-13. The boundaries for fidelity for the modulus and phase of the frequency response for Test 8

	Modulus		Phase [°]	
Frequency [rad/s]	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 F-14. The boundaries for fidelity for the modulus and phase of the frequency response for Test 9

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 F-15. The boundaries for fidelity for the modulus and phase of the frequency response for Test 10

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

8. NOTATIONS AND FRAMES OF REFERENCE

8.1	***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/s^2]
f	specific force	[m/s^2]
g	gravity	[m/s^2]
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]

8.2 ***Subscript indices***

A	aeroplane or aircraft
a/c	aircraft
S	simulator or FSTD
PA	aeroplane pilot
PS	FSTD pilot

8.3 ***Superscript indices***

x, y, z along the X, Y, and Z axis, respectively.

8.4 ***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 F-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 F_D.

Frame F_A

The aeroplane reference frame F_A has its origin at the aeroplane centre of gravity. 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.

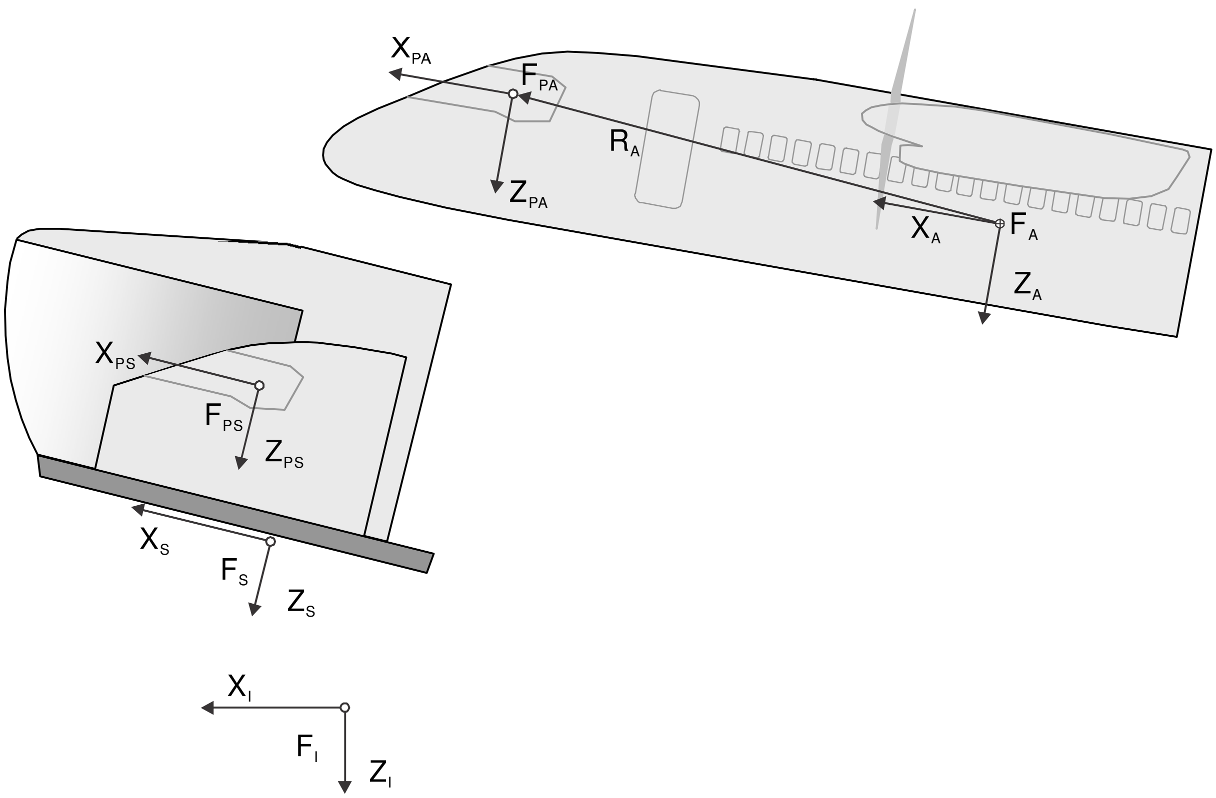

Figure F-6. Aeroplane and FSTD frames of reference relevant to MDAs.

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Attachment G

TRANSPORT DELAY AND LATENCY TESTING

1. BACKGROUND

1.1 The purpose of this attachment is to provide guidance on the methods for conducting transport delay and latency tests.

1.2 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 supplier for some cases described below.

1.3 The latency test is a second method that remains acceptable as an alternate means of compliance. Figure G-1 presents the principal of transport delay and latency testing.

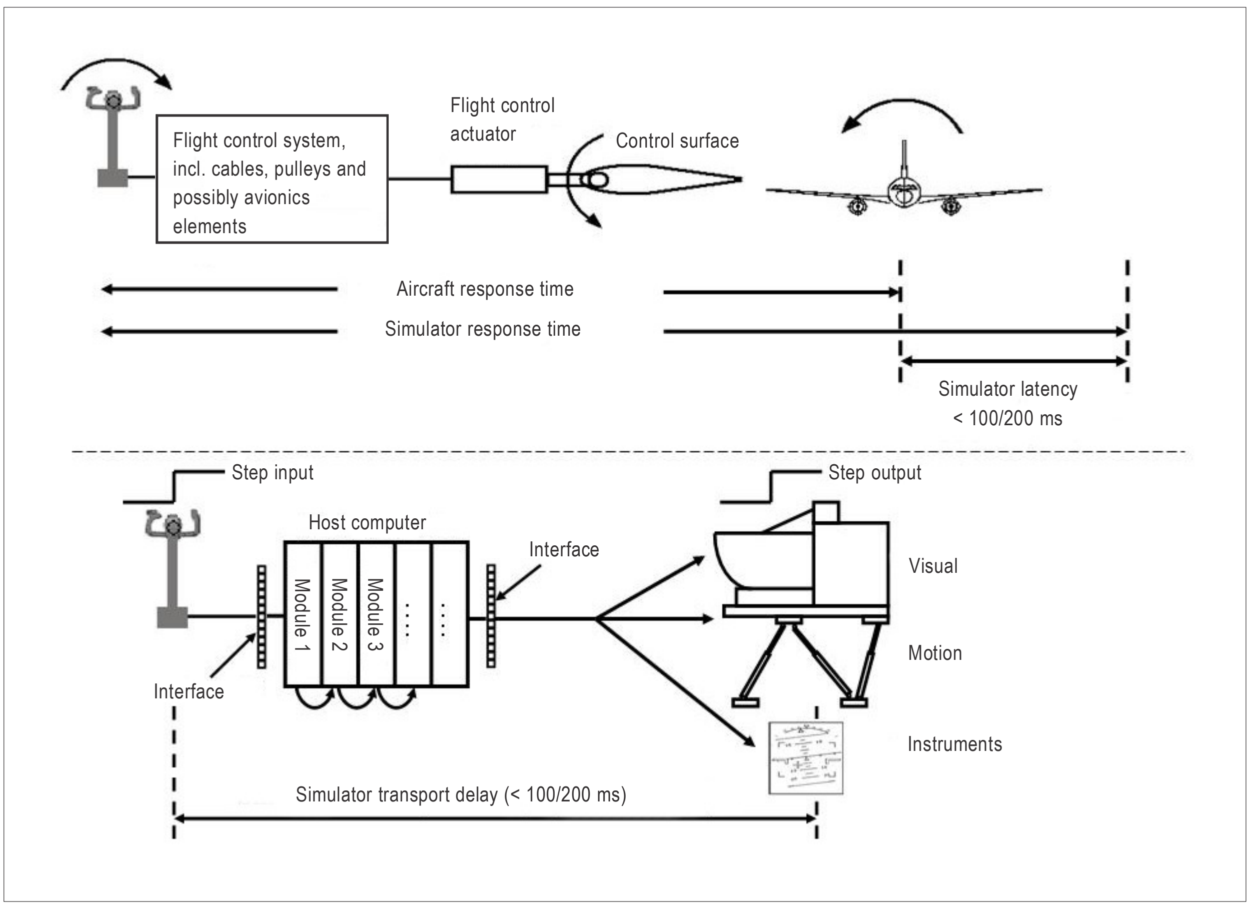

Figure G-1. Transport delay and latency testing

2. TRANSPORT DELAY

2.1 *Purpose*. This attachment describes how the transport delay introduced through the FSTD system should be measured and demonstrated to not exceed a specified 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 qualification. The transport delay needs to be measured from the 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.

2.2 In all cases, the simulation will have been demonstrated to be dynamically equivalent to the 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 re-run 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.

2.3 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 type of FSTD. The point of movement will be very simple to determine since both input and output signals will have clear leading edges.

2.4 *Non-computer-controlled aeroplanes*. In the case of classic, non-computer-controlled aeroplanes, no further analysis will be necessary.

2.5 *Computer-controlled aeroplanes*. For FSTDs of aeroplanes with electronic elements in the path between input from the pilot and resulting output, the measured transport delay will obviously 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 G-2).

2.5.1 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.

2.5.2 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, a statement of compliance (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.

2.6 *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 with all modules executed sequentially in one or more host processors. The flight controls input can occur at any time in the iteration, but these data will not be processed before the start of the new iteration. For an FSTD running at 60 Hz, a worst-case difference of 16.67 ms could be expected. Where multiple parallel processors or priority based execution systems are used, the scatter may be greater. Moreover, in some conditions, the host FSTD and the visual system do not run at the same iteration rate, therefore the output of the host computer to the visual will not always be synchronized.

2.7 **When offsetting the measured results by the throughput time of the avionics elements, it is also necessary to recognize that digital equipment will normally give a range of response times dependent upon the synchronization 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.**

2.8 *Recorded signals*. The signals recorded to conduct the transport delay calculations should be explained on the schematic block diagram. An explanation of why each signal was selected, and how it relates to the descriptions above, should also be provided.

2.9 *Visual system modes*. The transport delay test should account for both daylight and night modes of operation of the visual system. In both cases, the tolerance is as required in the validation test tables, and motion response needs to 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, backed up by a supporting statement.

3. LATENCY

3.1 The purpose of this section 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.

3.2 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 are required to support these tests.

3.3 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 manufacturer's 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 aeroplane response time, acceleration in the appropriate corresponding rotational axis is preferred.

3.4 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.

3.5 *Aeroplane response time*

3.5.1 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 are 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.

3.5.2 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 per cent of the maximum angular acceleration experienced. The elapsed time between the pilot control input and the aeroplane reaching 10 per cent of its maximum acceleration in ms should be used as the aeroplane response time.

3.6 *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.

3.7 *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.

3.8 *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.

3.9 *Computer-controlled aeroplanes and other special cases*. Guidance already provided above for the transport delay tests for computer-controlled aeroplanes and other special cases can be applied to the latency tests.

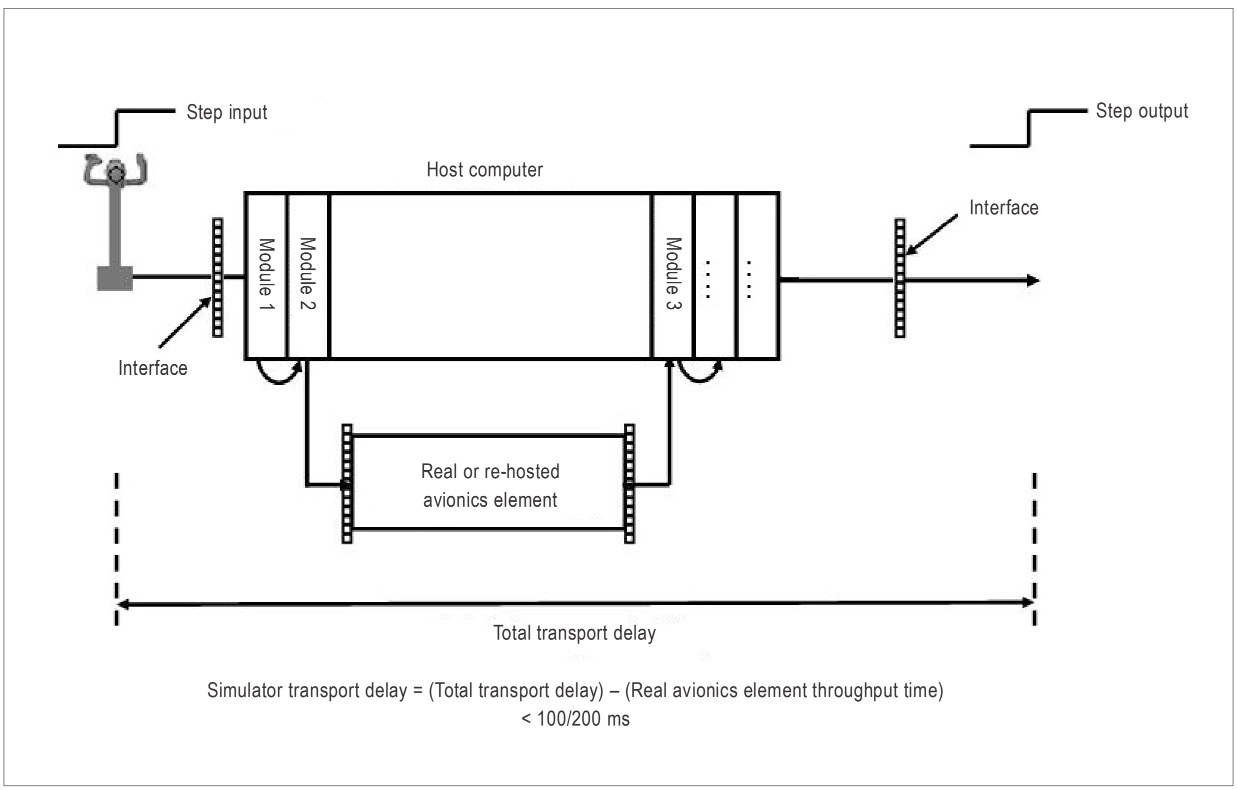

Figure G-2. Transport delay with avionics elements

Attachment H

RECURRENT EVALUATIONS — PRESENTATION OF VALIDATION TEST DATA

1. BACKGROUND

1.1 During the initial evaluation of an FSTD the MQTG is created. This is the master document, as amended, to which FSTD recurrent evaluation test results are compared.

1.2 Chapter 2, Section 2.5 describes the process for evaluation of validation test results for both initial and recurrent evaluations. The process will vary depending on the fidelity level of the FSTD feature being evaluated. Establishment of the MQTG is an important step in preparation for subsequent recurrent evaluations. Where the fidelity level is S, the approved data remain the baseline for recurrent evaluations. Where fidelity levels are G or R, with possible exceptions for sound and motion (see 1.3.2 below), the MQTG is a record of the reference data standard established during the initial evaluation and is the baseline for subsequent recurrent evaluations.

1.3 The currently accepted method of presenting recurrent validation test results is to provide FSTD results overplotted with the approved data, MQTG results or reference data standard. Test results are carefully reviewed to determine if the test is within the Appendix B tolerances. This can be a time consuming process, particularly when the data exhibit rapid variations or for an apparent anomaly requiring engineering judgment in the application of the tolerances. In these cases, the solution is to compare the results to the MQTG, and if they are the same, the test is accepted. Both the FSTD operator and the CAA are looking for any variance in FSTD validation test results since initial qualification.

1.3.1 Where the fidelity level is R and S and small deviations from the MQTG are seen, the test result is acceptable if the test is within the Appendix B tolerances when measured against the approved data.

1.3.2 Where the fidelity level is R, for Type V sound and Type VII sound and motion only:

a) in cases where approved subjective development has not been used and small deviations from the MQTG results are seen, the test result may still be acceptable if the test is within the Appendix B tolerances when measured against the approved data; and

b) in cases where approved subjective development has been used, the test result will be acceptable if the test is within the Appendix B tolerances when measured against the MQTG or reference data standard.

1.3.3 Where the fidelity level is G, the test result will be acceptable if the test is within the Appendix B tolerances when measured against the MQTG or reference data standard.

2. PRESENTATION OF RECURRENT EVALUATION TEST RESULTS

2.1 The method described below to present recurrent validation test results is offered solely to promote greater efficiency for FSTD operators 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.

2.2 FSTD operators are encouraged to overplot recurrent validation test results with MQTG results or reference data standard. As every MQTG test result is essentially a "foot-print" test for the FSTD, any variance in a validation test result will be readily apparent. A variance occurring in an established FSTD is 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 the MQTG test is at fault and should be updated. This should normally only occur during the first recurrent evaluation(s).

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

2.4 For all FSTD types, any variations between recurrent evaluation test results and MQTG test results or reference data standard are a probable indication of change. Investigation of any variance between the MQTG and recurrent FSTD performance should be conducted, particularly if these variations exceed tolerances explained above and if they cannot easily be explained, but this is left to the discretion of the FSTD operator and the CAA.

Attachment I

GUIDANCE ON DESIGN AND QUALIFICATION OF NON-TYPE-SPECIFIC FSTDs

1. BACKGROUND

Unlike type-specific FSTDs, non-type-specific FSTDs are intended to be representative of a group or class of aeroplanes. In other industry documents, the expression “generic device” has normally been used to designate such non-type-specific devices. However, in this attachment, the expression “generic device” has been replaced by “non-type-specific” to preclude confusion with the simulation feature fidelity G. It further reduces the implication that non-type-specific FSTDs are exclusively linked to G simulation feature fidelity levels as they could include R or even S fidelity levels of another aeroplane type than the main one of interest for the training programme. The guidance given in this attachment is applicable to the standard ICAO Type I to IV device categories, as defined in Chapter 2, Table 2-1.

2. DESIGN STANDARDS

2.1 *Simulated aeroplane configuration*

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

2.1.2 It would be in the interest of all parties to engage in early discussions with the CAA to broadly agree a suitable configuration, the so-called “designated aeroplane configuration”. Ideally any such discussion would take place in time to avoid any delays in the design/build/acceptance/qualification process thereby ensuring a smooth entry into service.

2.2 *Flight deck*. The flight deck should be representative of the designated aeroplane configuration. To ensure a good training environment, the flight deck should be sufficiently enclosed to minimize any distractions. The controls, instruments and avionics controllers should be representative with respect to touch, feel, layout, colour and lighting to create a positive learning environment and to allow for a good transfer of training to the aeroplane.

2.3 *Flight deck components*. As with any training device, the components used within the 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 would not be acceptable. The training tasks envisaged for non-type-specific FSTDs are such that appropriate layout and feel is very important. For example, the altimeter sub-scale knob needs to be physically located on the altimeter. The use of flat display technologies with physical overlays incorporating operational switches/knobs/buttons replicating an aeroplane instrument panel may be acceptable.

2.4 *Data package*

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

2.4.2 Validation data may be derived from a specific aeroplane within the group of aeroplanes that the FSTD is intended to represent, or they may be based on information from several aeroplanes within that group, reflecting the designated aeroplane configuration. It is recommended that the intended validation data together with a substantiation report be submitted to the CAA for evaluation and approval prior to the commencement of the manufacturing process.

2.4.3 For validation tests with G fidelity requirements where the required tolerances are CT&M, validation data are not required. Rather, subjective testing of the FSTD will be used to produce a baseline (footprint) objective test result, against which the recurrent test result will be compared during recurrent evaluations. In this case, an engineering report should be provided. This report may include flight test data, manufacturer's design data, information from the flight manual and maintenance manuals, results of approved or commonly accepted simulations or predictive models, recognized theoretical results, information from the public domain, or other sources as deemed necessary by the FSTD manufacturer to substantiate the proposed model.

2.4.4 *Data collection and model development*. 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 and new technologies (e.g. GPS).

2.4.5 Any such data gathering should take place at representative masses and centres of gravity. 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, cg, atmospheric conditions), should be carefully documented and available for inspection by the CAA as part of the qualification process.

2.5 *Flight controls*. There can be a strong interaction between the flight control forces and the effects of both the engines and the aerodynamic configuration. For this reason an active force feedback cueing system in which forces vary not only with position but with configuration (speed, flaps, trim) will be necessary for the representative R fidelity level of the flight controls and forces simulation feature. For the representative R1 and generic G fidelity levels of the same simulation feature, a passive force cueing system utilizing springs would be acceptable. It should be emphasized that it is vitally important to prevent negative learning and that negative characteristics would not be acceptable.

3. VISUAL SYSTEM

3.1 The emergence of lower-cost raster-only daylight systems is recognized for non-type-specific FSTDs. The adequacy of the performance of the visual system will be determined by its ability to support the intended training tasks, e.g. "visual cueing sufficient to support changes in approach path by using runway perspective".

3.2 For non-type-specific FSTDs, collimated visual optics are probably not necessary. A single-channel direct viewing system would probably be acceptable as no training credits for landing will be available. Distortions due to non-collimation would only become significant during on-ground or near-to-the-ground operations. The risk in using that approach is that, should the device be subsequently upgraded to conduct training for multi-crew operations, the non-collimated visual system may be unacceptable.

3.3 Where an FSTD does not simulate a particular aeroplane type, the design of the out-of-flight-deck view should be matched to the visual system so that the pilot has a FOV sufficient for the intended 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 normal approach path, undue loss of visual reference should not occur during the subsequent correction.

4. SYSTEM INTEGRITY

4.1 For a non-type-specific FSTD, a transport delay test may be used to demonstrate that the FSTD system does not exceed the permissible delay. However, for such an FSTD using simple models, a statement of compliance may be acceptable in lieu of a test.

4.2 The maximum permissible transport delay and tests to determine compliance with this requirement may be found in Attachment G.

5. TESTING/EVALUATION

5.1 To ensure that an FSTD meets its design criteria initially and periodically throughout its life, a system of objective and subjective testing will be used.

5.2 The validation tests specified in Appendix B can be carried out by a suitably skilled person and the results recorded manually. Bearing in mind the cost implications, the use of automatic recording and testing increases the repeatability of the achieved results and is therefore encouraged.

5.3 The tolerances specified in Appendix B are designed to ensure that the FSTD meets its original target criteria year after year. It is therefore important that such target data are carefully derived and values are agreed with the appropriate CAA in advance of any formal qualification process. For initial qualification, it is highly desirable that the FSTD meet its design criteria within the listed tolerances. However, unlike the tolerances stipulated for type-specific devices, the tolerances stated for non-type-specific FSTDs are purposely intended to be used to ensure repeatability during the life of the FSTD and in particular at each recurrent evaluation.

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

5.5 *Longitudinal change force tests.* For the Type II and IV devices, it is acceptable to use change force tests instead of the longitudinal power, flap and gear change dynamics tests. The purpose of these change force tests is to simply reproduce the control force feeling during recurrent evaluations. However, if automatic testing is used, a change dynamics test is equally acceptable. If not otherwise stated, these tests should be conducted in the following way:

a) trim the aeroplane in straight and level flight in the most suitable configuration;

b) initiate the configuration change (power, flap or gear change);

c) maintain the airspeed constant using the pitch control (or as an alternate procedure, maintain the altitude of the original trimmed conditions); and

d) measure the required pitch control force change.

5.6 The subjective tests listed in Appendix C should be carried out by a suitably qualified and experienced pilot.

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Attachment J

APPLICABILITY OF CAA REGULATION AMENDMENTS TO FSTD DATA PACKAGES FOR EXISTING AEROPLANES

1. GENERAL POLICY

1.1 Except where specifically indicated otherwise within the table of FSTD validation tests in Appendix B, validation data for QTG objective tests are expected to be derived from aeroplane flight tests.

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

1.3 For types of aeroplanes first entering into service after the publication of an amendment of the CAA regulations, the provision of acceptable data to support the FSTD qualification process is a matter of planning and regulatory agreement (see Attachment A).

1.4 For aeroplanes type-certificated prior to the applicability of a new amendment of CAA regulations, it may not always be possible to provide the required data for any revised or additional objective test cases compared to the previous amendments of the regulations. After prototype 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.

1.5 Notwithstanding the above discussion, the preferred source of validation data is flight test, though other types of data may be acceptable (see, for example, Attachment B). It is expected that best endeavours will be made by data suppliers to provide the required flight test data. If any flight test data exist that address the requirement (collected during the certification or any other flight test campaign), such test data should be provided. If any possibility exists to obtain these flight test data during the occasion of a new flight test campaign, this should be done and provided in the data package at the next issue. Where flight test data are genuinely not available, alternative sources of data may be acceptable using the following hierarchy of preferences:

a) flight test at an alternate but near-equivalent condition/configuration substantiated by one or more rationale(s) to explain the choice;

b) data from an audited engineering simulation from an acceptable source (for example, meeting the guidelines laid out in Attachment B), or as used for aeroplane certification;

c) aeroplane performance data published by the aeroplane manufacturer in documents such as the aeroplane flight manual, operations manual, performance engineering manual or equivalent, or other approved published sources (e.g. production flight test schedule) for the following tests:

   1) 1.c (1) — normal climb all engines operating;

   2) 1.c (2) — one-engine-inoperative 2nd segment climb;

   3) 1.c (3) — one-engine-inoperative en-route climb;

4) 1.c (4) — one-engine-inoperative approach climb for aeroplanes with icing accountability;

5) 1.e (3) — stopping distance, wheel brakes, wet runway; and

6) 1.e (4) — stopping distance, wheel brakes, icy runway; and

d) where no other data are available, then the following sources may be acceptable subject to a case-by-case review with the CAA concerned, taking into consideration the level of qualification sought for the FSTD:

1) unpublished but acceptable sources (e.g. calculations, simulations); or

2) footprint test data from the actual FSTD undergoing qualification, validated by pilot subjective assessment.

1.6 In certain cases, it may make good engineering sense to provide more than one test to support a particular objective test requirement. An example might be a V_{mcg} test, where the flight test engine and thrust profile do not match the simulated engine. The V_{mcg} 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.

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

1.8 These rationales should be clearly recorded within the validation data roadmap (VDR) in accordance with and as defined in Attachment D.

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

2. RECOMMENDATION FOR THE USE OF FOOTPRINT TESTS

2.1 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 CAA concerned taking into consideration the level of qualification sought for the FSTD.

2.2 Footprint test data should be:

a) constructed with initial conditions and the FSTD being set up in the configuration required for the required data (e.g. correct engine thrust rating);

b) a manoeuvre representative of the particular aeroplane being simulated;

c) based on a footprint test manoeuvre manually flown by a type-rated pilot (see note below) who is current on type and approved by the CAA;

d) constructed from validation data obtained from the footprint test manoeuvre and transformed into an automatic test;

e) used in an automatic test run as a fully integrated test with pilot input controls;

f) automatically run for the initial qualification and recurrent evaluation supplemented, whenever possible, with flight test data which will further substantiate the intended purpose and key aspects of the test being presented; and

g) supplemented, whenever possible, with flight test data which will further substantiate the intended purpose and key aspects of the test being presented.

Note.— The pilot flying the manoeuvre should sign off the complete test as being fully representative.

2.3 A clear rationale should be included in the QTG for each footprint test. These rationales should be added to and clearly recorded within the VDR in accordance with and as defined in Attachment D.

2.4 Where the number of footprint tests is deemed by the CAA to be excessive, the FSTD level of qualification may be affected and lowered. The CAA should review each area of validation test data that proposes the use of footprint tests as the basis for the validation data. Consideration should be given to the extent to which footprint tests are used in any given area. For example, it would be unacceptable if all or the vast majority of take-off tests were proposed as footprint tests, with little or no flight test data being presented. It should be recognized, therefore, that it may be necessary for new flight test data to be gathered if the use of footprint tests becomes excessive, not just overall, but also in specific areas.

2.5 For recurrent evaluation purposes a close match is to be expected (see Attachment H). Validation tests using footprint data, which do not meet the test criteria, should be addressed to the satisfaction of the CAA.

2.6 The CAA should be consulted well in advance of the QTG submission if footprint tests are to be used.

Attachment K

GUIDANCE FOR THE QUALIFICATION OF AN FSTD HEAD-UP DISPLAY (HUD)

1. APPLICABILITY

1.1 This procedure applies to all FSTDs with a head-up display (HUD) installation.

1.2 For the purposes of this attachment, “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.

1.3 This attachment details one means to evaluate and qualify an FSTD HUD system. If an FSTD operator desires to use other means, a proposal should be submitted to the CAA for review and approval.

1.4 QTGs for new, updated or upgraded FSTDs incorporating a HUD system should contain a HUD statement of compliance (SOC). The SOC should be an attestation that HUD hardware and software, including associated displays, function the same way as that 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.

2. FSTD/HUD STANDARDS

2.1 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.

2.2 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 CAA. Display format of the repeater should replicate that of the combiner.

3. OBJECTIVE TESTING

3.1 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 Appendix B.

3.2 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.

4. SUBJECTIVE TESTING

4.1 The CAA evaluator should evaluate accurate replication of HUD functions.

4.2 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 authorized should be tested. The evaluation should be conducted using daylight, dusk and night conditions.

a) pre-flight inspection of the HUD system;

b) taxi:

   1) HUD taxi guidance;

   2) combiner horizon matches the visual horizon within the manufacturer's tolerance;

c) take-off:

   1) normal take-off in visual meteorological conditions (centreline guidance if available);

   2) instrument take-off using the lowest RVR authorized for the particular HUD;

   3) engine-out take-off;

   4) maximum demonstrated crosswind take-off;

   5) wind shear during take-off;

d) in-flight:

   1) climb;

   2) turns;

   3) cruise;

   4) descent;

e) approaches:

   1) normal approach in visual meteorological conditions;

   2) 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;

   3) engine-out approach and landing;

4) non-precision approach;

5) circling approach, if applicable;

6) missed approach — normal and engine-out;

7) maximum demonstrated crosswind approach and landing;

8) wind shear on approach;

f) malfunctions:

1) malfunctions causing abnormal pre-flight tests;

2) malfunctions logically associated with training during take-off and approach; and

3) malfunctions associated with any approved flight manual abnormal procedures which are not included above.

4.3 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.

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Attachment L

GUIDANCE FOR THE QUALIFICATION OF AN FSTD ENHANCED FLIGHT VISION SYSTEM (EFVS)

1. APPLICABILITY

1.1 This procedure 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 Attachment K.

1.2 For the purposes of this attachment, "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 a HUD combiner glass in the normal "out-the-window" view.

1.3 This attachment details one means to evaluate and qualify an FSTD EFVS system. If an FSTD operator desires to use other means, a proposal should be submitted to the CAA for review and approval.

1.4 QTGs for new, updated or upgraded FSTDs incorporating an EFVS system should contain an EFVS statement of compliance (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.

2. FSTD/EFVS STANDARDS

2.1 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.

2.2 The FSTD requirements for qualifying an EFVS system in an FSTD are:

a) the EFVS FSTD hardware/software, including associated flight deck displays and annunciation, should function in the same or in an equivalent way to the EFVS system installed in the aeroplane;

b) an active display (repeater) of the pilot's combiner should be located on the instructor operating station (IOS), or at another location approved by the CAA. 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

c) a minimum of one aerodrome should be modelled for EFVS. That model should have an ILS and a non-precision approach (with VNAV if required by the AFM for that aeroplane type) available. In addition to EFVS modelling, the aerodrome model should meet all other applicable visual requirements for that device.

3. OBJECTIVE TESTING

Both on-ground 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 CAA. Time histories are required unless otherwise indicated. See Appendix B for the specific test requirements.

4. SUBJECTIVE TESTING

4.1 Handling qualities, performance, and FSTD systems operation, while using the EFVS system, should be subjectively assessed.

4.2 The ground and flight tests and other checks required for qualification of the EFVS system are listed below. The evaluation should be conducted using daylight, dusk, and night conditions, daylight being the most difficult to simulate.

a) pre-flight inspection of the EFVS system to include all EFVS warnings and annunciations;

b) taxi:

1) parallax caused by sensor position;

2) ground hazards, especially other aeroplanes;

3) signs may appear as a block (unreadable) due to the absence of temperature variation between the letters and the background, with an infrared sensor;

c) take-off:

1) normal take-off in night visual meteorological conditions;

2) instrument take-off with visual system visibility set to enable an RVR of 180 m (600 ft);

d) in flight:

1) image horizon should be conformal with the visual and combiner horizons;

2) visual meteorological conditions night or dusk scene; a thunderstorm should be detected out to a distance of at least 37 km (20 NM);

e) approaches:

1) normal approach in night visual meteorological conditions;

2) ILS approach;

3) non-precision approach;

4) missed approach;

Note.— Emphasis should be placed on the FSTD's capability to demonstrate that the EFVS system is able to display the required visual cues for the pilot to descend below the published decision *height (DH). The HUD 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 through the HUD.*

f) visual segment and landing:

1) from non-precision approach;

2) from precision approach;

g) abnormal procedures:

1) EFVS malfunctions on the ground; and

2) EFVS malfunctions in the air.

4.3 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 150 m (500 ft) AGL, at CAT I and EFVS authorized minima, and below minima to force a go-around.

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Attachment M

GUIDANCE FOR THE EVALUATION OF A FLIGHT PROCEDURES TRAINING DEVICE (FPTD)

1. INTRODUCTION

1.1 FSTD operators have used flight procedures training devices (FPTD), previously referred to as part task trainers, for many years as an integral part of their training programme. This attachment provides guidance on the evaluation of FPTDs and may be useful in assessing their acceptability for use in an air operator's approved training programme.

1.2 Some FPTDs have been used to acquire flight time training credits, while others have not. Those that provide flight time training credits have been qualified by the CAA. Within the context of this attachment, a flight time training credit is accredited time used to reduce required flight training time in the aeroplane or in a higher level FSTD. An FSTD operator considering an FPTD qualification should refer to Parts I and III and consult its CAA.

2. REQUIREMENTS

2.1 An FPTD is an aeroplane type-specific device to be used to train for explicit tasks. It does not have to fly or have flight controls. It should have at least one system simulated. This device can range in complexity from very simple to very sophisticated, i.e. from a simple programming unit for an FMS control and display unit to a full size flight deck that replicates all auto-flight functions of the aeroplane. Flat panel trainers have significant utility in an FSTD operator's ground school programme and, particularly with some associated hardware, may also be useful as an FPTD within the air operator's approved training programme.

2.2 Table M-1 contains the minimum requirements for an FPTD. The first column in the table provides the requirement number from the table in Appendix A. There are no validation test requirements. The FPTD is meant to be evaluated through the applicable tests of Appendix C to Part III.

2.3 Table M-2 is a suggested method of recording the training and possible checking capability when using the FPTD. The table is generic and meant to cover most aeroplane types and systems. The FSTD operator is encouraged to modify the table to meet its needs by adding new events and/or deleting extraneous items. The recommended use of Table M-2 is for the FSTD operator to record all the intended training tasks in the table. During the FPTD evaluation, the CAA would accept or reject the use of the FPTD for each listed task. This will prevent wasting time in trying to determine every task that the FPTD could be capable of when the FSTD operator only intends to utilize the FPTD for a limited list of tasks.

2.4 Table M-3 is a suggested method to record the functionalities available in the instructor operating station to support the training tasks.

2.5 The information in the tables should be considered to be a "living document" allowing the FSTD operator to approach the CAA for changes.

Table M-1. FPTD requirements

App A #	Requirement	Comments
1.1	FLIGHT DECK STRUCTURE	
	An open, enclosed or perceived to be enclosed flight deck area with aeroplane-like, if installed or as applicable, primary and secondary flight controls, engine and propeller controls, equipment, systems, instruments, panels and associated controls, assembled in a spatial manner to resemble that of the aeroplane being simulated.	The assembled components should be compatible and function in a cohesive manner. FPTD instruments and/or instrument panels using electronically displayed images with or without physical overlay or masking are acceptable. The instruments displayed should be free of quantization (stepping). Aeroplane-like controls, instruments and equipment means corresponding to the aeroplane being simulated. If the FPTD is convertible, some may have to be changed for some conversions.
1.2	SEATING	
	Flight crew member seats should be appropriate for the aeroplane, providing the flight crew member(s) with a representative design eyepoint in relation to equipment and instruments, as applicable, and representative posture at the controls, if fitted. In addition to the flight crew member and instructor station seats, there should be two suitable seats for an observer and CAA inspector.	Seats may be as simple as a regular chair.
1.3	FLIGHT DECK LIGHTING	
	Lighting environment for panels and instruments should be sufficient for the training tasks being conducted.	
2.	FLIGHT MODEL	
2.1	The device is not required to fly, but, if applicable, aerodynamic and engine modelling should be broadly representative of the aeroplane being simulated and of sufficient fidelity to support the simulated systems (e.g. FMS and autopilot).	
3.	GROUND REACTION AND HANDLING CHARACTERISTICS	Not required.
4.	AEROPLANE SYSTEMS (ATA CHAPTERS)	
4.1	NORMAL, ABNORMAL AND EMERGENCY SYSTEMS OPERATION	
	Aeroplane systems represented in the FPTD should simulate the aeroplane system(s) operation including system interdependencies, both on the ground and in flight, as applicable. At least one aeroplane system should be represented.	Once activated, proper systems operation should result from system management by the crew member and should not require any further input from the instructor's controls. There is no requirement for other than normal system operation unless required by the air operator’s approved training programme.

App A #	Requirement	Comments
4.2	CIRCUIT BREAKERS	
	Circuit breakers required for any training event should be functionally representative of those in the aeroplane and the effects should be accurate.	Circuit breaker panels, if provided, need not be spatially correctly located. Circuit breakers presented in a flat panel display should be considered as “functionally representative” towards procedural knowledge training credits (see Table M-2).
4.3	INSTRUMENT INDICATIONS	
	As or if applicable, any relevant instrument indications involved in the simulation of the aeroplane should automatically respond to control movement by a flight crew member or auto-flight device including autopilot and auto-thrust systems.	The device is not required to fly.
4.4	COMMUNICATIONS, NAVIGATION AND CAUTION AND WARNING SYSTEMS	
	If installed, communications, navigation, and caution and warning equipment should be aeroplane-like, with operation within the tolerances prescribed for the applicable equipment.	As a minimum, aeroplane-like communications, navigation, and caution and warning equipment means corresponding to the aeroplane being simulated. If the FPTD is convertible, some equipment may have to be changed for some conversions.
5.	FLIGHT CONTROLS AND FORCES	
5.3	CONTROL SYSTEM OPERATION	
	If installed, the flight control system should be aeroplane-like, and should allow basic aeroplane operation with appropriate resultant flight deck indications.	As a minimum, as per Appendix A, flight controls should have a “G” fidelity level, except that the controls should correspond to the aeroplane being simulated. Force feedback is not required.
6.	SOUND CUES	
6.1	SOUND SYSTEM	
	If installed, any significant flight deck sounds simulated during normal and abnormal operations should be aeroplane-like, corresponding to the aeroplane being simulated, and may include engine and airframe sounds as well as those which result from pilot-induced or instructor-induced actions.	As a minimum, as per Appendix A, sound cues should have a “G” fidelity level, except that the sound should correspond to the aeroplane being simulated.
6.4	SOUND VOLUME	
	The volume control should have an indication of the sound level setting to be accepted during the initial evaluation.	If a sound system is installed.
7.	VISUAL CUES	Not required, but, if installed, the visual system should meet, as a minimum, the Part III, Appendices A, B and C visual cue requirements for the “G” fidelity level.
8.	MOTION CUES	Not required.

App A #	Requirement	Comments
9.	ENVIRONMENT — ATC Simulated ATC environment is not required, but is recognized as a desirable feature in FPTDs.	Where simulated, the system should include those features that best support the training objectives. Simulated ATC environment features should meet the Part III, Appendices A, B and C requirements for the "G" fidelity level.
10.	ENVIRONMENT — NAVIGATION	
	If applicable, navigational database with the corresponding departure, en-route and approach facilities and procedures within the planned area of operations. Navigation aids should be usable within range without restriction.	Navigational database should be maintained with regular updates, as mandated by the CAA for such a system.
13.	MISCELLANEOUS	
13.2	INSTRUCTOR CONTROLS	
	Instructor controls for all required system variables, freezes and resets, and for insertion of malfunctions to simulate abnormal or emergency conditions, as appropriate.	
13.4	COMPUTER CAPACITY	
	Sufficient FPTD computer capacity, accuracy, resolution and dynamic response to fully support the overall FPTD fidelity needed to meet the intended training.	
13.6	UPDATES TO FPTD HARDWARE AND SOFTWARE	
	Timely permanent update of FPTD hardware and software subsequent to FPTD manufacturer recommendation where it affects training capability and/or safety.	
13.7	DAILY PRE-FLIGHT DOCUMENTATION	
	Daily pre-flight documentation either in the daily log or in a location easily accessible for review is required.	

Note.— The numbering of the first column of Table M-1 corresponds to the numbering of the relevant requirements listed in Appendix A.

Table M-2. Suggested list of training and checking tasks for an FPTD

LEGEND

N — device is not suitable or not applicable to task.
1 — suitable for procedural knowledge training.
2 — suitable for skill training related to task (T).
3 — suitable for manoeuvre training and checking for the task (TP).

Event	1	2	3
Preparation for flight			
Pre-flight			N
APU/engine start and run-up			
Engine start:			
Normal start			N
Alternate start procedures			N
Abnormal starts and shutdowns			N
Pushback		N	N
Taxi		N	N
Thrust response			N
Throttle lever functionality			
Brake operation (normal, alternate, emergency)			N
Brake fade (if applicable)			N
Take-off			
Normal operations:			
Engine checks			
Acceleration characteristics		N	N
Nosewheel and rudder steering		N	N
Effect of crosswind		N	N
Special performance		N	N
Instrument take-off			N
Gear, flap/slat operation			N
Abnormal/emergency operations:			
Rejected take-off		N	N
Rejected special performance take-off		N	N
Failure of critical engine at V_1		N	N
Flight control system failure modes		N	N
Wind shear		N	N

Event	1	2	3
Climb			
Normal climb			N
Engine(s) inoperative procedures		N	N
Cruise			
Performance (speed versus power)			
Turns with/without spoilers			N
High altitude handling			N
High speed handling			N
Mach effects on control and trim		N	N
Overspeed warning			
Normal and steep turns		N	N
Approach to stall:			
1) Cruise		N	N
2) Take-off/approach		N	N
3) Landing		N	N
High angle of attack manoeuvres:			
1) Cruise		N	N
2) Take-off/approach		N	N
3) Landing		N	N
In-flight engine shutdown		N	N
In-flight engine restart		N	N
Manoeuvring with engine(s) inoperative		N	N
Manual flight control reversion		N	N
Flight control system failure modes:			
1) Normal flight dynamics			N
2) Abnormal flight dynamics		N	N
Descent			
Normal operations			N
Maximum rate of descent			N
Manual flight control reversion		N	N
Flight control system failure modes:			
1) Normal flight dynamics			N
2) Abnormal flight dynamics		N	N

Event	1	2	3
Approaches			
Non-precision approach with autopilot:			
1) LOC/BC			
2) LOC			
3) NDB			
4) VOR			
5) GPS			
6) RNAV			
With one or more engines inoperative			N
Non-precision approach without autopilot:			
1) LOC/BC			N
2) LOC			N
3) NDB			N
4) VOR			N
5) GPS			N
6) RNAV			N
With one or more engines inoperative		N	N
Precision approach:			
ILS:			
CAT I — Autopilot			N
CAT I — Manual:			
1) with flight director		N	N
2) without flight director		N	N
CAT II:			
1) auto-coupled			N
2) auto-throttle operations			N
3) autoland operations			N
CAT III:			N
Effects of crosswind		N	N
With one or more engines inoperative		N	N
Visual approach (as applicable):			
With VASIS/PAPI		N	N
Without VASIS/PAPI		N	N

Event	1	2	3
Missed Approach:			
With autopilot:			
1) normal missed approach			N
2) with an engine inoperative			N
3) with engine failure during G/A		N	N
Manual missed approach:			
1) normal missed approach		N	N
2) with an engine inoperative		N	N
3) with engine failure during G/A		N	N
Landing			
Normal operations:			
Autoland			N
With maximum demonstrated crosswind		N	N
From a visual approach		N	N
From a non-precision approach		N	N
From a precision approach		N	N
From a circling approach		N	N
Abnormal/emergency operations:			
With one or more engine(s) inoperative		N	N
Rejected landing		N	N
With wind shear		N	N
With standby power		N	N
Manual flight control reversion		N	N
Fly-by-wire most degraded mode		N	N
Flight control system failures		N	N
Surface operations (after landing)			
Landing roll:			
Spoiler operation			N
Reverse thrust operation		N	N
Directional control with and w/o reverse		N	N
Brakes — Autobrakes only			N
Engine shutdown and parking:			
Systems operation			
Parking brake operation			

Event	1	2	3
Aircraft and engine systems			
Air conditioning			
Anti-icing/de-icing			
Auxiliary power unit			
Communications			
Electrical system (generators, transformer-rectifier units, bus configurations)			
Fire detection and suppression			
Flaps:			
Normal flight characteristics			N
Abnormal flight characteristics		N	N
Flight controls modes:			
Normal characteristics			N
Abnormal characteristics		N	N
Fuel and oil			
Hydraulics:			
Normal characteristics			
Abnormal characteristics		N	N
Landing gear:			
Normal operations			N
Alternate/emergency operations			N
Oxygen			
Pneumatics			
Engines:			
Normal characteristics			N
Abnormal characteristics		N	N
Pressurization			
Protections and warnings:			
1) Overspeed		N	N
2) Minimum speed		N	N
3) Load factor		N	N
4) Pitch angle		N	N
5) Bank angle		N	N
6) Angle of attack		N	N
Radar			

Event	1	2	3
ECAM/EICAS:			
Normal operations			
Abnormal/emergency operations			
Electronic checklists:			
Normal operations			
Alternate/emergency operations			
TCAS: TA, RA and TA only			
Flight management and guidance systems:			
Automatic landing aids			N
Autopilot			N
Thrust management/auto-throttle			N
Flight data display/annunciation			N
Flight management computers			N
Flight director/system displays:			
Conventional display			N
Head-up display			N
Navigation system:			
Conventional			N
GPS or performance-based navigation			N
Stall warning/avoidance		N	N
GPWS/EGPWS		N	N
Wind shear warning/avoidance		N	N
Airborne procedures			
Holding			
Air hazard avoidance			N

Table M-3. Instructor operating station functions

Instructor operating station (IOS)	√
Power switch(es)	
Aeroplane conditions:	
Gross mass, cg, fuel load, etc.	
Aeroplane systems status	
Ground crew functions	
Airports and landing areas:	
Number and selection	
Runway selection	
Runway surface condition	
Preset positions	
Lighting controls	
Environmental controls:	
Clouds (base and tops)	
Visibility	
Runway visual range	
Temperature	
Wind speed and direction	
Aeroplane system malfunctions:	
Insertion/deletion	
Malfunction clearance	
Locks, freezes, repositioning:	
Parameter freeze/release	
Position freeze/release	
Repositioning	
Ground speed control	
Remote IOS	
Sound controls	
On/off/rheostats	
Observer stations	

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Attachment N

ALTERNATE REFERENCE LINE EVALUATION METHOD FOR FLIGHT CONTROL DYNAMICS EVALUATION

1. BACKGROUND

1.1 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[1] 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.

1.2 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 below.

2. ALTERNATE REFERENCE LINE

2.1 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 N-1). 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.

2.2 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 N-2).

2.3 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.

2.4 Link all the reference points to obtain the alternate reference line (see Figure N-2), and append the final non-dynamic portion to it.

---

1. The rest position is defined as the position where the control would eventually settle if no pilot force 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.

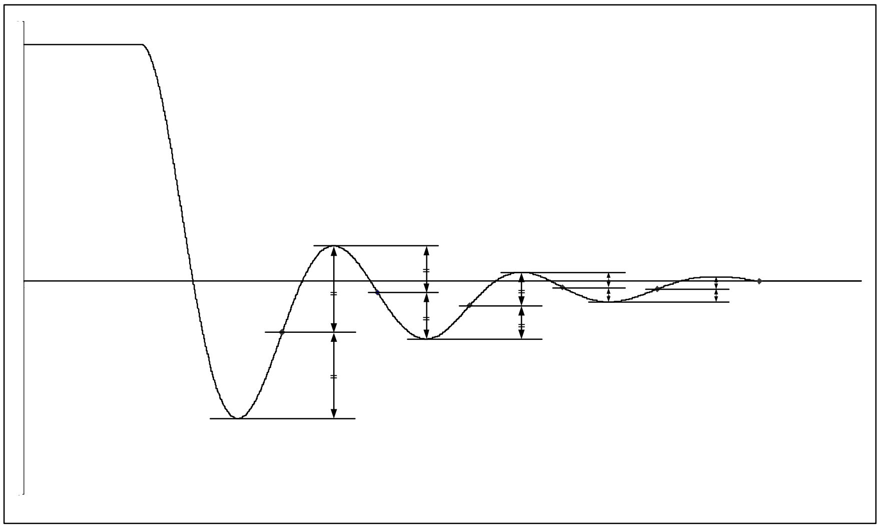

Figure N-1. Locating median points

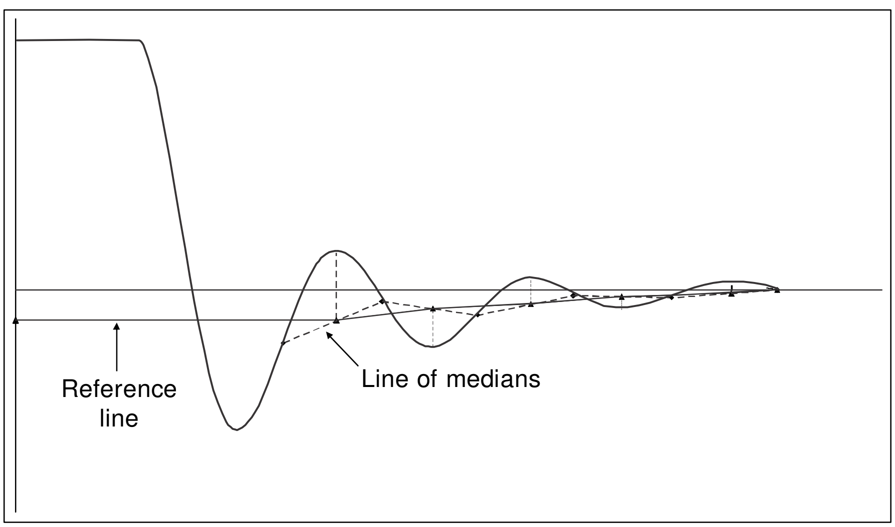

Figure N-2. Producing the final alternate reference line

3. TOLERANCES

The final alternate reference line (see Figure N-3) may be used to calculate the conventional tolerances described in Appendix B, paragraph 3.2.2.2. Note that the residual band $T(A_d)$ should be at a distance of ±5 per cent of A_d or ±0.5 per cent of the total control travel (stop to stop) from the alternate reference line. Its shape will therefore follow the alternate reference line.

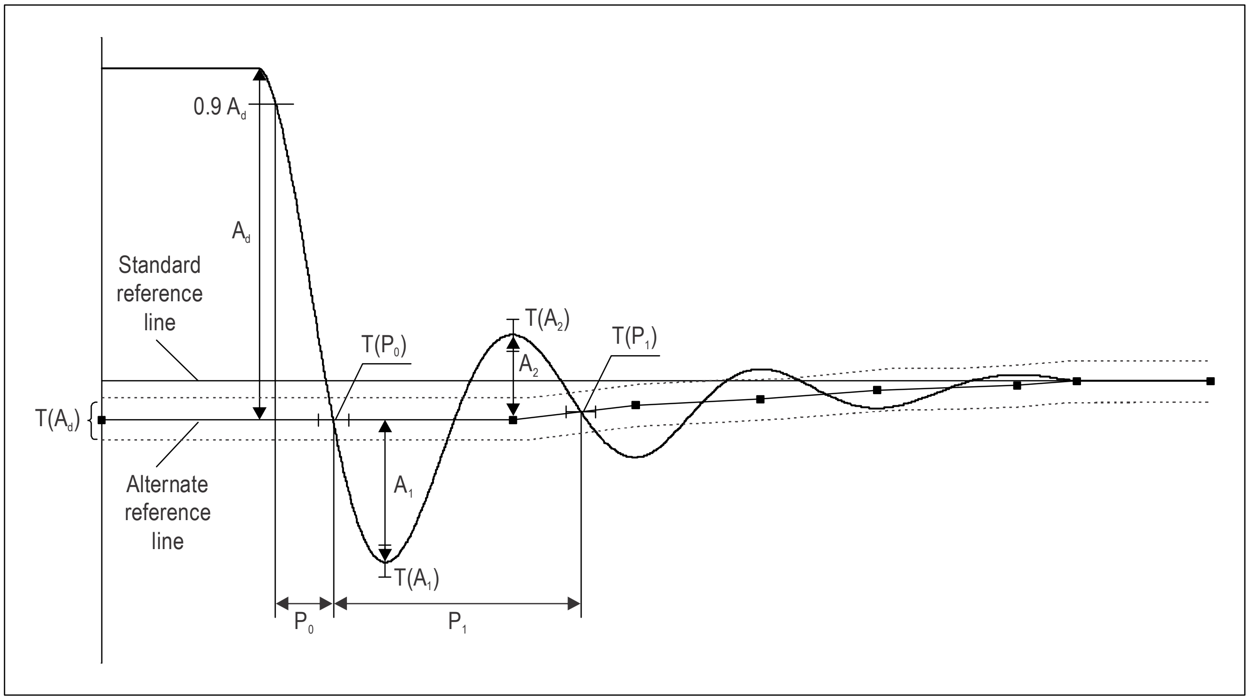

Figure N-3. Tolerances applied using the alternate reference line

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Attachment O

GUIDANCE FOR ENVIRONMENT — ATC

1. It is recognized that the flight simulation and training industry is currently developing training requirements and applications to enhance the simulation of the ATC environment. The use of simulated ATC environment in training is still in the adoption, testing and refinement stages of its life cycle.

2. The features and requirements contained in Appendices A, B and C in Parts II and III of this manual concerning simulated ATC environment are not mandatory for either training approval or FSTD qualification at this time. The content of these appendices should be used as guidance to industry for the continued development and refinement of simulated ATC environment in FSTDs and other flight training tools. Further guidance material will be published in subsequent amendments to this manual when sufficient experience has been gathered and requirements further reviewed and matured by industry.

3. Primary efforts by industry should be aimed at delivering simulated ATC environment throughout the MPL and other ab initio flight training programmes, including initial TR. Once simulated ATC environment has been introduced and validated, the benefits will be highly advantageous to all subsequent advanced training.

4. Experience has already demonstrated that early exposure to the ATC environment, even prior to first FSTD training, would be of significant benefit to student pilots. Training organizations should give consideration to extending simulated ATC environment training using Flight Procedures Training Devices (FPTDs) and other mobile or classroom-based tools. Attachment M contains guidance for the evaluation of FPTDs.

5. Further information that may be of help to FSTD operators and vendors on simulated ATC environment is available in ARINC Report 439 (see Chapter 2, 2.3.3).

Attachment P

FSTD QUALIFICATION GUIDANCE FOR UPSET RECOVERY/STALL/ICING MANOEUVRES

1. INTRODUCTION

1.1 This attachment consists of the supplemental guidance material that is recommended for use in the acceptable means of compliance to qualify an FSTD for the conduct of training in approach to stall manoeuvres, stall manoeuvres beyond the critical angle of attack (applicable only if required by the national regulations or elected by the FSTD operator), upset recovery manoeuvres and flight in engine or airframe icing conditions, as a complement to the FSTD requirements in Appendices A, B and C to Parts II and III.

1.2 Although consulted throughout the development of both Doc 10011 — *Manual on Aeroplane Upset Prevention and Recovery Training* and this manual, aeroplane original equipment manufacturers (OEMs) may at some point develop differing guidance regarding recovery techniques to address these areas of training. In such instances, OEM guidance should take precedence over recommendations contained within these manuals.

2. STALL MANOEUVRE EVALUATION

2.1 *Fidelity requirements.* The objective testing requirements as defined for the stall manoeuvre are intended to validate:

a) aeroplane type-specific recognition cues of the first indication of the stall (such as stall warning system and/or aerodynamic stall buffet);

b) aeroplane type-specific recognition cues of an impending aerodynamic stall; and

c) recognition cues and handling qualities from the stall break through recovery that are sufficiently exemplar of the aeroplane being simulated to allow successful completion of the stall entry and recovery training tasks, as may be prescribed in national regulations.

For the purposes of stall manoeuvre evaluation, the term “exemplar” is defined as a level of fidelity that is type-specific of the aeroplane being simulated to the extent that the training objectives can be satisfactorily accomplished.

2.2 *Statement of compliance (SOC).* Traditionally, flight test collected data have been the preferred data source for FSTD objective evaluation required for qualification. It is recognized, however, that strict time-history-based evaluation against flight test data may not adequately validate the aerodynamics model in an unstable flight regime, such as stalled flight, particularly in cases where significant deviations are seen in the aeroplane’s stability and control. As a result, the SOC-based approach for evaluating the aerodynamics model at angles of attack approaching the stall was implemented to allow for the aerodynamics modeller and data provider to develop enhanced exemplar stall models which are based upon generally accepted engineering and scientific principles. Examples may include:

a) stall models developed using the aeroplane OEM’s engineering simulation;

b) wind tunnel or established analytical methods to extend stall modelling sufficiently to achieve an exemplar full stall and recovery; and

c) expert input from a pilot who has full-stall experience in the aeroplane being simulated.

As described in the objective testing section, stall qualification requires SOCs detailing the information described in 2.3 through 2.5 below.

2.3 *Aerodynamics modelling.* The SOC should identify the sources of data used to develop the aerodynamics model. Of particular interest is a mapping of test points in the form of an alpha/beta envelope plot for a minimum configuration set of flaps up and flaps down. The envelopes are defined in section 3 below and examples can be found in Appendix 3-D of the *Airplane Upset Recovery Training Aid* (see Chapter 2, 2.3). For the flight test data, a list of the types of manoeuvres used to define the aerodynamics model for angle of attack ranges greater than the first indication of stall is to be provided per flap setting. To allow for full stall training where angle of attack excursions may briefly exceed the critical angle of attack while executing a recovery, model validation and/or analysis should be conducted through at least 10 degrees beyond the critical angle of attack. In cases where limited data are available to model and/or validate the stall characteristics due to safety of flight issues, the data provider is expected to make a reasonable attempt to develop a stall model through analytical methods and utilization of the best available data.

2.3.1 At a minimum, the following stall model features should be incorporated into the aerodynamics model as appropriate, and addressed in the SOC where applicable for the aeroplane type:

a) degradation in static/dynamic lateral and/or directional stability;

b) degradation in control response (pitch, roll, yaw);

c) uncommanded roll acceleration or roll-off requiring significant control deflection to counter;

d) apparent randomness or non-repeatability;

e) changes in pitch stability;

f) Mach effects; and

g) stall buffet.

An overview of the methodology used to address these features should be provided.

2.4 *Subjective assessment.* The stall model should be evaluated by an SME pilot with knowledge of the cues necessary to accomplish the required training objectives and experience in conducting stalls in the type of aeroplane being simulated. It may be appropriate for a CAA to consult, in some cases, with an aeroplane manufacturer on the designation of an SME. An SME cannot be self-proclaimed. The designation of an SME is related to a certain type of aeroplane and manoeuvres and is linked to the SME's recency of experience in the manoeuvres on the aeroplane type. Final evaluation and approval of the operator's FSTD should be accomplished by an SME pilot with knowledge of the training requirements to conduct the stall training tasks. The purpose of the subjective evaluation is to provide an additional layer of protection to ensure FSTD fidelity. The intent is for the simulation to be qualified initially only once by an SME. Objective recording can then be made and used without an SME for initial or recurrent qualification of FSTDs for the same aeroplane make, model and series. This evaluation may be conducted in the operator's FSTD or in an "audited" engineering simulation. The engineering simulation can then be used to provide, in addition to the stall model, objective validation test cases and subjective evaluation guidance material to the FSTD operator for evaluation of the implemented model.

2.5 Where available, documentation, including validation test documentation from an acceptable provider, OEM documentation or other source documentation related to stall training tasks for the aeroplane being simulated should be utilized. Particular emphasis should be placed upon recognition cues of an impending aerodynamic stall (such as the stall buffet or lateral and/or directional instability), stall break (g-break, pitch break, roll-off departure, etc.), response of aeroplane automation (such as autopilot and autothrottles) and the necessary control input required to execute an immediate recovery.

2.6 *Stick pusher system modelling.* For aeroplanes equipped with a stick pusher system, the required SOC should verify that the stick pusher system/stall protection system has been modelled, programmed and validated using the aeroplane manufacturer's design data or other approved data source. At a minimum, the following characteristics should be addressed in the SOC:

a) stick pusher activation logic;

b) stick pusher system dynamics, control displacement, and forces; and

c) stick pusher cancellation logic.

3. UPSET RECOVERY MANOEUVRE EVALUATION

3.1 *Basic requirements. T*he basic elements for the qualification of upset recovery training manoeuvres are:

a) to verify that the FSTD can be expected to remain within its designed validation envelope during the execution of approved upset recovery training tasks; and

b) to provide the instructor/evaluator with a minimum set of feedback tools to properly evaluate the trainee's performance in accomplishing an upset recovery training task.

3.2 *Flight envelopes definition.* For the purposes of this attachment, the term "flight envelope" refers to the entire domain in which the FSTD is capable of being flown with a degree of confidence that the FSTD responds similarly to the aeroplane. This envelope can be further divided into three subdivisions (see Appendix 3-D of the *Airplane Upset Recovery Training Aid*):

a) 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 utilized to further extend the model beyond the minimum requirements. Within this region, there is high confidence that the FSTD responds similarly to the aeroplane. 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 can be considered to be within the flight test validated region.

b) Wind tunnel and/or analytical region. This is the region of the flight envelope for which the FSTD has not been compared to flight test data, but for which there has been wind tunnel testing and/or the use of other reliable predictive methods (typically by the aeroplane manufacturer) to define the aerodynamics model. Within this region, there is moderate confidence that the FSTD responds similarly to the aeroplane.

c) Extrapolated region. This is the region extrapolated beyond the flight test validated and wind tunnel/analytical regions. The extrapolation may be a linear extrapolation, a holding of the last value before the extrapolation began, or some other set of values. If these extrapolated data are provided by the aeroplane or FSTD manufacturer, it is a "best guess" only. Within this region, there is **low** confidence that the FSTD responds similarly to the aeroplane. Brief excursions into this region may still retain a moderate confidence level in FSTD fidelity. However, the instructor should be aware that the FSTD's response may deviate from the actual aeroplane.

3.3 *Instructor feedback mechanism.* For the instructor/evaluator to provide feedback to the trainee during upset prevention and recovery training (UPRT), additional information should be accessible that indicates the fidelity of the simulation, the magnitude of trainee's flight control inputs and aeroplane operational limits that could potentially affect the successful completion of the manoeuvre(s). Additionally, key aeroplane parameters, such as altitude and aeroplane attitudes should be presented. While outside the scope of an FSTD qualification document, it is essential that the training provider ensure that UPRT instructors have been properly trained to interpret the data provided by these IOS feedback tools. Satisfactory feedback should be provided in three principal areas, as discussed below:

a) FSTD validation envelope. The FSTD should employ a method to record the FSTD's fidelity with respect to the FSTD validation envelope. This should be displayed as an angle of attack versus sideslip (alpha/beta) envelope cross-plot on the IOS or other alternate method to clearly convey the FSTD's fidelity level during the manoeuvre. The cross-plot should display the relevant validity regions for flaps up and flaps down at a minimum. This presentation should include a time history of the manoeuvre relative to the fidelity ranges and should be available for debriefing. Refer to Carbaugh[1] for the limitations associated with this display. Satisfactory training for FSTD instructors is necessary on the alpha/beta envelope cross-plot so that they interpret it appropriately.

b) Flight control inputs. The FSTD should 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, should be portrayed in this feedback mechanism as well as for debriefing. For passive sidesticks, whose displacement is the flight control input, the force applied by the pilot to the controls does not need to be displayed. This tool should include a time history of flight control positions.

c) Aeroplane operational limits. The FSTD should provide the instructor/evaluator with information concerning the aeroplane operating limits. The parameters of the aeroplane being simulated should be displayed dynamically in real time and recorded for debrief purposes. The time history should be displayed graphically in a manner and format that makes information available and useful to the instructor. The ability to record and playback these parameters is strongly encouraged.

3.4 Specifically, it is highly recommended that the display should represent the load factor and speeds with a boundary of operational load and airspeed limits. This display should be constructed in accordance with the OEM's data and should incorporate the OEM's operating recommendations.

3.5 An example of an FSTD "alpha/beta" envelope cross-plot, V-n display and IOS feedback mechanism used by an FSTD manufacturer is shown in Figures P-1, P-2 and P-3.

Note 1.— In Figure P-1, the dots are green, orange and red if within the flight test, wind tunnel or extrapolation validated areas of the flight model, respectively. The yellow dot is a time reference since the start of the plot (here 22 seconds). There is one data dot for every second but the user can select the number of displayed plot points (here 8).

Note 2.— In Figure P-2, the dots are green, orange and red if within the green normal envelope, the caution envelope (outside the green normal envelope and bounded by the V_{SS} speed at 1-g, the dotted orange lines and the stall curve between 1-g and 2.5-g) and outside those two envelopes, respectively. The yellow dot is a time reference since the start of the plot (here 57 seconds). There is one data dot for every second but the user can select the number of displayed plot points.

1. Carbaugh David, AIAA 2008-6866, *Simulator Upset Recovery Training and Issues*

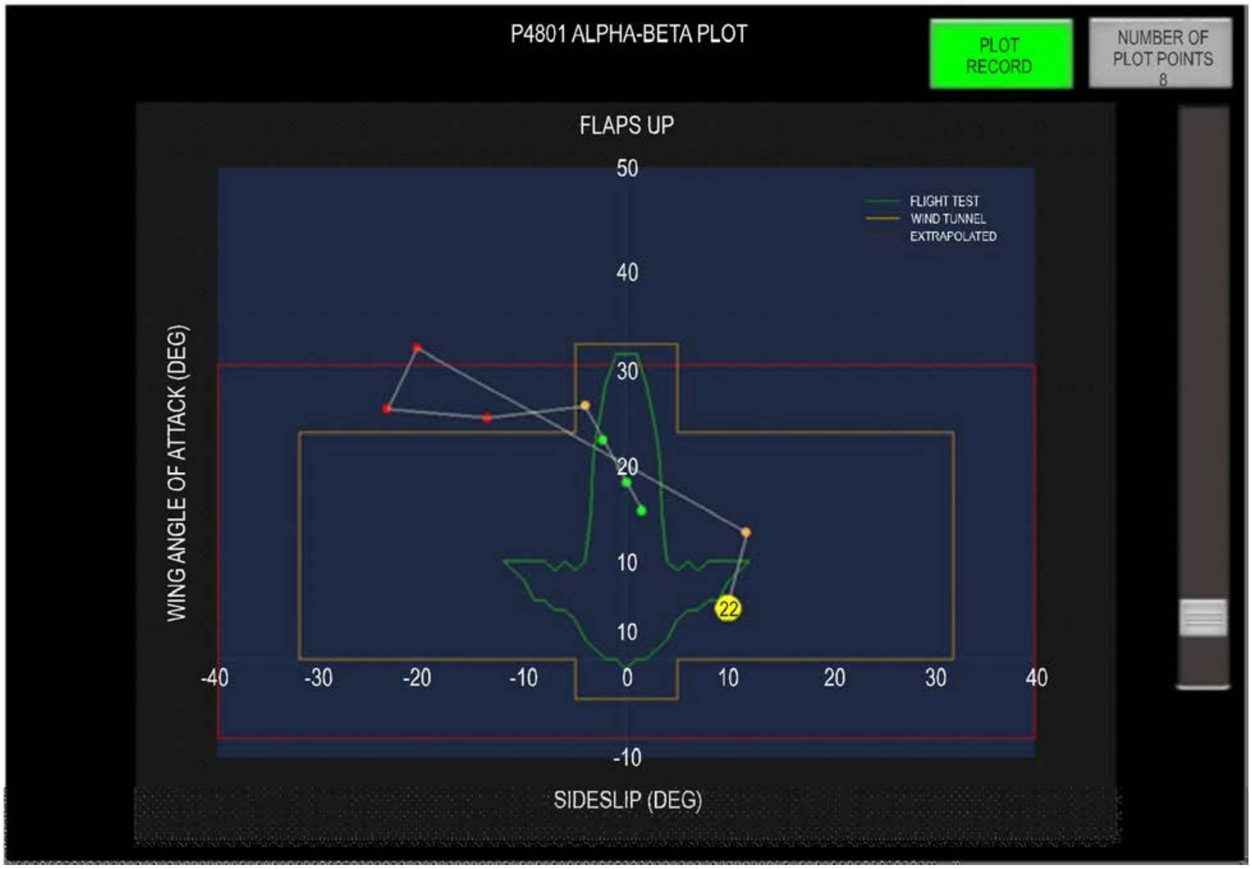

Figure P-1. Example of alpha/beta envelope plot

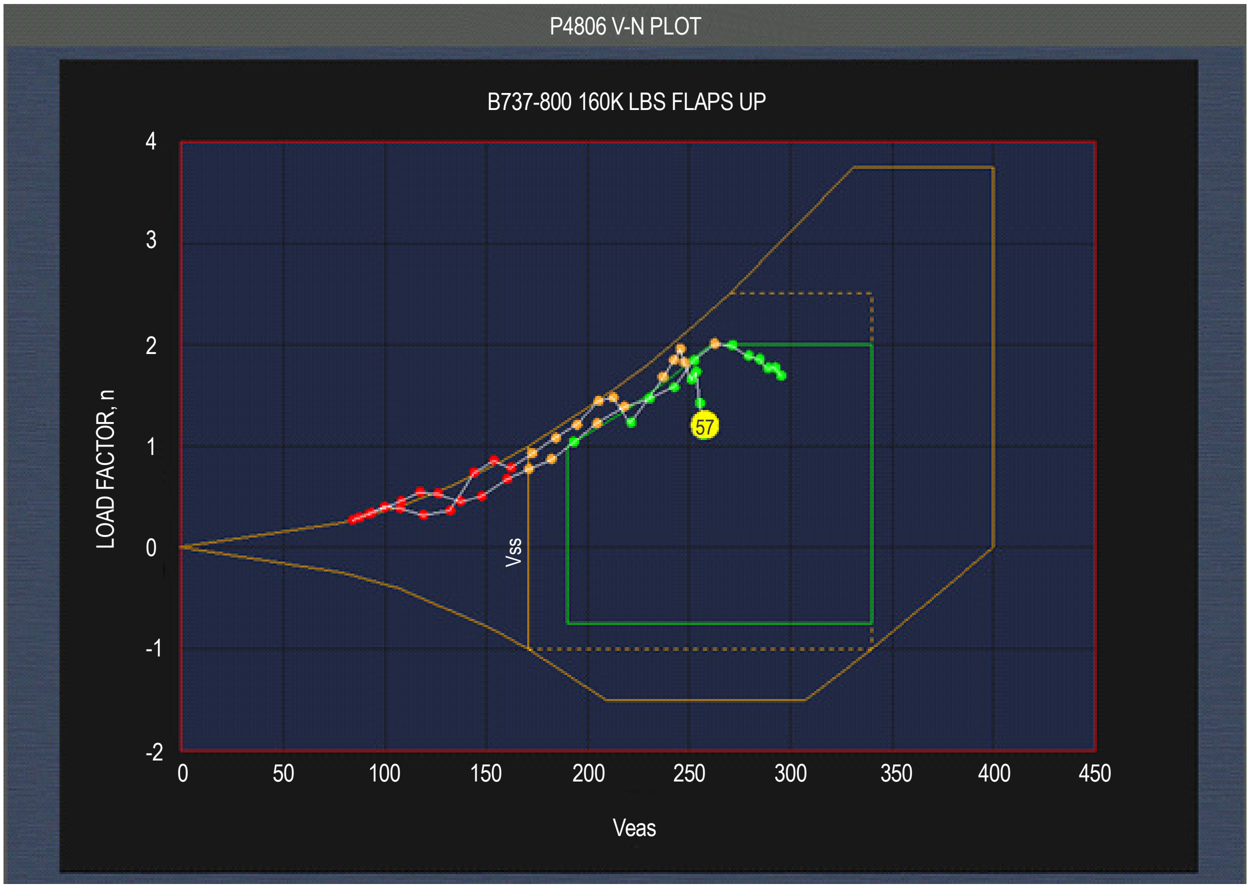

Figure P-2. Example of V-n display

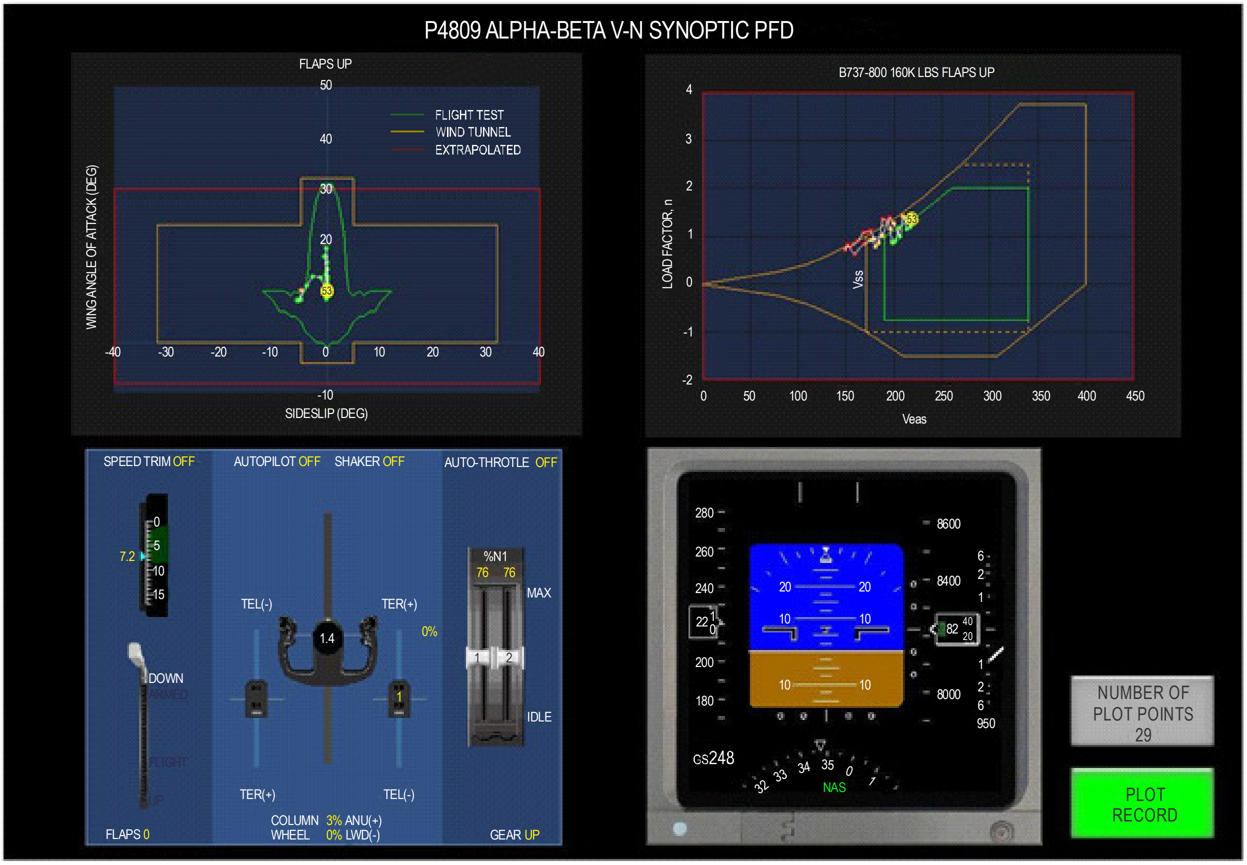

Figure P-3. Example of an instructor feedback display

4. ENGINE AND AIRFRAME ICING EVALUATION

4.1 *Basic requirements.* This section applies to all FSTDs that are used to satisfy training requirements for engine and airframe icing. New general requirements and objective requirements for FSTD qualification have been developed to define aeroplane-specific icing models that support training objectives for the recognition and recovery from an in-flight ice accretion event.

4.2 Ice accretion models should be developed to account for training the specific skills required for recognition of ice accumulation and execution of the required response. The qualification of engine and airframe icing simulation consists of the following elements that should be considered when developing ice accretion models for use in training:

a) ice accretion models should be developed in a manner to contain aeroplane-specific recognition cues as determined with aeroplane OEM's supplied data or other suitable analytical methods; and

b) at least one qualified ice accretion model should be objectively tested to demonstrate that the model has been implemented correctly and generates the correct cues as necessary for training.

4.3 *SOC.* The required SOC should contain the following information to support qualification as described in the table of general requirements:

a) a description of expected aeroplane-specific recognition cues and degradation effects due to a typical in-flight icing encounter. Typical cues or effects may include 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. This description should be based on relevant source data, such as aeroplane OEM's supplied data, accident/incident data or other acceptable data source. Where a particular airframe has demonstrated vulnerabilities to a specific type of ice accretion (due to accident/incident history), which may require specific training (such as supercooled large-droplet icing or tailplane icing), ice accretion models should be developed that address the training requirements; and

b) a description of the data sources utilized to develop the qualified ice accretion models. Acceptable data sources may be, but are not limited to, flight test data, aeroplane OEM's engineering simulation data or other analytical methods based upon established engineering principles.

4.4 *Objective demonstration test.* The purpose of the objective demonstration test is to demonstrate that the ice accretion models as described in the SOC have been implemented correctly and demonstrate the proper cues and effects as defined in the approved data sources. At least one ice accretion model should be selected for testing and included in the MQTG. Two tests are required to demonstrate engine and airframe icing effects. One test will demonstrate the FSTDs baseline performance without icing, and the second test will demonstrate the aerodynamic effects of ice accretion relative to the baseline test.

4.5 *Recorded parameters.* In each of the two required MQTG tests, a time history recording should be made of the following parameters:

a) altitude;

b) airspeed;

c) normal acceleration;

d) engine power settings;

e) angle of attack and pitch attitude;

f) roll angle;

g) flight control inputs;

h) stall warning and stall buffet threshold of perception; and

i) other parameters as necessary to demonstrate the effects of ice accretion.

4.6 **Demonstration manoeuvre.** The FSTD operator should select an ice accretion model as identified in the SOC for testing. The selected manoeuvre should demonstrate the effects of ice accretion at high angles of attack from a trimmed condition through approach to stall and "full" stall as compared to a baseline (no ice build-up) test. The ice accretion models should demonstrate the cues necessary to recognize the onset of ice accretion on the airframe, lifting surfaces and engines, and provide exemplar degradation in performance and handling qualities to the extent that a recovery can be executed. Typical ice accretion effects that may be present depending upon the aeroplane being simulated include:

a) decrease in stall angle of attack;

b) increase in stall speed;

c) increase in stall buffet threshold of perception speed;

d) changes in pitching moment;

e) changes in stall buffet characteristics;

f) changes in control effectiveness or control forces; and

g) engine effects (power variation, vibration, etc.).

Tests may be conducted by initializing and maintaining a fixed amount of ice accretion throughout the manoeuvre to evaluate the effects.

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MANUAL OF CRITERIA FOR THE QUALIFICATION OF FLIGHT SIMULATION TRAINING DEVICES

Volume I

Aeroplanes

Part III

Flight Simulation Feature and Fidelity Level Criteria

Chapter 1

GLOSSARY OF TERMS, ABBREVIATIONS AND UNITS

The terms, abbreviations and units used in this document are described in Part II, Chapter 1.

Chapter 2

INTRODUCTION

Note.— In this part, all references to an appendix point to content in Part III of this document unless otherwise indicated.

2.1 PURPOSE

2.1.1 Part III provides the information to determine the requirements and qualification criteria for an aeroplane FSTD defined using the process described in Part I, Chapter 3, from the simulation features according to training task considerations. It also establishes the performance and documentation requirements for evaluation by CAAs of the defined FSTDs used for training and testing or checking of flight crew members. The process described in Part I of this Volume is new, but the requirements and methods of compliance were derived from the extensive experience of CAAs and industry.

2.1.2 Part III is intended to provide the means for a CAA to validate the definition of a new FSTD type or variant of an existing FSTD type and to qualify such an FSTD, subsequent to a request by an applicant, through initial and recurrent evaluations of the FSTD. Further, this document is intended to provide the means for a CAA of other States to accept the qualifications granted by the State which conducted the initial and recurrent evaluations of an FSTD, without the need for additional evaluations, when considering approval of the use of that FSTD by applicants from their own State.

2.2 BACKGROUND

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

2.2.2 The FSTD requirements provided in this chapter are derived from training requirements which have been developed through a training task analysis, the details of which are fully presented in Part I. Part I also defines the process for identifying a new FSTD that may be a variation of one of the existing FSTD types defined in Part II, or may be unique. Part III provides the information to enable identification of the requirements and testing for such a new FSTD.

2.2.3 The MPL content is preliminary and offers a means by which the FSTD requirements may be satisfied but should not be treated as the only means by which the FSTD requirements of an MPL programme may be met. The relevant text in this manual will be updated when the pertinent information from the completion of the MPL programmes implementation phase becomes available.

2.2.4 The summary matrix example (see Table 2-1) should be used to define the new FSTD type by correlating the appropriate training tasks for a given training type against fidelity levels for key simulation features. The resulting

FSTD types should have the capability to be used in the training and, if applicable, testing or checking towards the chosen training tasks in relation to licences or ratings. Training types that can be used for this process are those listed in Part I, Chapter 4. The introduction of a new training type, new tasks or variations in tasks may not be supported by this document and would require the appropriate training task analysis by an authorized body before they could be considered for the process used here. The terminology used in the table below for training type, device feature and level of fidelity of device feature is defined as follows:

2.2.4.1 Training types:

MPL1	Multi-crew Pilot Licence — Phase 1, Core flying skills;
MPL2	Multi-crew Pilot Licence — Phase 2, Basic;
MPL3	Multi-crew Pilot Licence — Phase 3, Intermediate;
MPL4	Multi-crew Pilot Licence — Phase 4, Advanced;
IR	Initial Instrument Rating;
PPL	Private Pilot Licence;
CPL	Commercial Pilot Licence;
TR	Type Rating Training and Checking;
ATPL	Airline Transport Pilot Licence or Certificate;
CR	Class Rating;
RL	Recurrent Licence Training and Checking;
RO	Recurrent Operator Training and Checking;
IO	Initial Operator Training and Checking;
CQ	Continuing Qualification; and
Re	Recency (Take-off and Landing).

2.2.4.2 FSTD features:

Flight Deck Layout and Structure
Flight Model (Aerodynamics and Engine)
Ground Handling
Aeroplane Systems (ATA Chapters)
Flight Controls and Forces

Sound Cues
Visual Cues
Motion Cues

Environment — ATC
Environment — Navigation
Environment — Atmosphere and Weather
Environment — Aerodromes and Terrain

Miscellaneous — (Instructor Operating Station, etc.)

2.2.4.3 Device feature fidelity level:

S (Specific)	—	Highest level of fidelity
R (Representative)	—	Intermediate level of fidelity
G (Generic)	—	Lowest level of fidelity
N (None)	—	Feature not required

For detailed definitions of fidelity levels S, R, G and N, see Chapter 1, Section 1.1.

2.2.5 Training codes:

2.2.5.1 Device qualified as T only. The introduction of a specific training task. The training accomplished may be credited towards the issuance of a licence, rating, or qualification, but the training would not be completed to proficiency. The fidelity level of one or more of the simulation features may not support training-to-proficiency.

2.2.5.2 Device qualified as TP. The introduction, continuation, or completion of a specific training task. The training accomplished may be credited towards proficiency and/or the issuance of a licence, rating, or qualification, and the training is completed to proficiency. The fidelity level of all simulation features supports training-to-proficiency.

Table 2-1. FSTD Summary Matrix Example of a Δ (Delta) Device

Note.— Guidance on the qualification criteria determination process is contained in Part I, Chapter 3.

Device Type	Licence or Type of Training	Train (T) or Train-to-Proficiency (TP)	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
			Device Feature											
Type V	ATPL/TR/IO/RO/RL	T	S	S	S	S	S	R	R	N	G	S	R	R
	Training Type 1/ Training Task 1		R	S	S	S	S	R	R	N	G	S	R	R
	Training Type 1/ Training Task 2		R	S	S	S	S	R	R	N	G	S	R	R
	Training Type 1/ Training Task 3		R	R	R	R	R	G	R	N	G	S	R	R
	Training Type 2/ Training Task 1		R	S	S	S	S	R	R	N	G	R	R	R
	Training Type 2/ Training Task 2		R	S	S	S	S	R	R	N	G	S	G	R
	Training Type 2/ Training Task 3		R	S	S	S	S	R	R	N	G	S	R	G
Type V Δ	**Roll Up Summary**		**R**	**S**	**S**	**S**	**S**	**R**	**R**	**N**	**G**	**S**	**R**	**R**

2.2.6 Notes for the use of Table 2-1 to define the desired Δ (delta) device type:

2.2.6.1 Selection of a unique set of training tasks from Part I, Appendix C for the desired training programme will identify the fidelity level signatures of the FSTD features for those tasks. Populating the table with these feature fidelity levels and use of the roll-up process (selection of the highest fidelity level for each feature) will result in the Δ device feature fidelity signature. Another consideration in the definition of the device is that individual feature fidelity levels cannot be treated in isolation. The training device will be used in an integrated manner and certain features may have a dependency upon other features for integrated operation. This may result in the FSTD fidelity level signature having to be altered to ensure compatibility among dependent features. Paragraphs 2.2.6.3 and 2.2.6.4 below describe the treatment of integrated feature fidelity levels for validation testing and functions and subjective testing.

2.2.6.2 Correlation of the new device feature fidelity signature against the information provided in Appendix A will provide the necessary requirements for the Δ device type.

2.2.6.3 Correlation of the new device feature fidelity signature against the information provided in Appendix B will provide the necessary validation tests for the Δ device type. Examples of the inter-dependency of features which require the same fidelity level for various integrated tests are provided in the validation test tables in Appendix B. For the purpose of evaluation, 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.

2.2.6.4 Correlation of the new device feature fidelity signature against the information provided in Appendix C will provide the necessary functions and subjective tests for the Δ device type. The functions and subjective tests are all executed in an environment where FSTD features are used in a fully integrated manner. The integrated nature of the testing environment prevents these functions and subjective tests from being classified by feature fidelity level. Where any new type of FSTD is created, it will inevitably have a collection of different feature fidelity levels in its construction, which precludes the possibility of classifying tests for those "device types" using the categories G, R and S. To avoid the possibility of confusion by associating tests for those "device types" with G, R and S, the feature fidelity levels are not presented in the table in Appendix C. Instead, the complete functions and subjective tests list as used in Part II, Appendix C is provided with a single blank column under the heading "Applicability". For any new device type created, an appropriate functions and subjective tests list will have to be defined from this master list. This should be done by analysis of the applicable training tasks that the device will support as presented in Part I and by entering ticks in the "Applicability" column for appropriate test cases. This list needs to be agreed with the relevant CAA. Examples of this can be seen in Part II, Appendix C where similar exercises were conducted for device Types I to VII.

2.2.6.5 The “Miscellaneous” simulation feature does not appear in the table because it is not addressed by the training task analysis. Judgement should be applied to determine which “Miscellaneous” items are required.

2.2.7 The FSTD general and technical requirements defined in Appendix A are grouped by device feature and fidelity level. The FSTD validation tests and functions and subjective tests found in Appendices B and C are grouped by relevant device feature and fidelity level.

2.2.8 If considering using this process, the appropriate CAA should be consulted very early.

2.3 RELATED READING MATERIAL

2.3.1 Applicants seeking FSTD evaluation, qualification and approval for use of aeroplane FSTDs should consult references contained in related documents published by the International Civil Aviation Organization (ICAO), the International Air Transport Association (IATA) and the Royal Aeronautical Society (RAeS) referring to and/or dealing with the use of FSTDs and technical and operational requirements relevant to FSTD data and design. Applicable rules and regulations pertaining to the use of FSTDs in the State for which the FSTD qualification and approval is requested should also be consulted. These are referred to in Part II, Chapter 2, 2.3.2 and 2.3.3.

2.3.2 It is important to regularly monitor regulatory guidance material on the CAA web sites to understand the latest regulatory opinion on new technology or practices.

2.4 FSTD QUALIFICATION

2.4.1 In dealing with FSTDs, CAAs differentiate between the technical criteria of the FSTD and its use for training/testing and checking. The FSTD should be evaluated by the CAA taking into consideration the aeroplane manufacturer's recommended training practices. Qualification is achieved by comparing the FSTD performance against the criteria specified in the Qualification Test Guide (QTG) for the qualification level sought.

2.4.2 The validation, functions and subjective tests required in the QTG enable the CAA to "spot check" the performance of the FSTD in order to confirm that it represents the aeroplane in some significant training and testing or checking areas. Without such spot checking, using the QTG, FSTD performance cannot be verified in the time normally available for the regulatory evaluation. It should be clearly understood that the QTG does not provide for a rigorous examination of the quality of the simulation in all areas of flight and systems operation. The full testing of the FSTD is intended to have been completed by the FSTD manufacturer and its operator prior to the FSTD being submitted for the regulatory evaluation and prior to the delivery of the results in the QTG. This "in depth" testing is a fundamental part of the whole cycle of testing and is normally carried out using documented acceptance test procedures in which the test results are recorded. These procedures will test the functionality and performance of many areas of the simulation that are not addressed in the QTG as well as such items as the instructor operating station.

2.4.3 Once the FSTD has been qualified, the authority responsible for oversight of the activities of the user of the FSTD can approve what training tasks can be carried out. This determination should be based on the FSTD qualification, the availability of FSTDs, the experience of the FSTD user, the training programme in which the FSTD is to be used and the experience and qualifications of the pilots to be trained. This latter process results in the approved use of an FSTD within an approved training programme.

2.5 TESTING FOR FSTD QUALIFICATION

2.5.1 The FSTD should be assessed in those areas which are essential to completing the flight crew member training and testing or checking process. This includes the FSTD's longitudinal and lateral-directional responses; performance in take-off, climb, cruise, descent, approach and landing; all-weather operations; control checks; and pilot, flight engineer and instructor station functions checks. The motion, visual and sound systems should be evaluated to ensure their proper operation.

2.5.2 The intent is to evaluate the FSTD as objectively as possible. Pilot acceptance, however, is also an important consideration. Therefore, the FSTD should be subjected to the validation tests listed in Appendix B and the functions and subjective tests in Appendix C. Validation tests are used to objectively compare FSTD and aeroplane data to ensure that they agree within 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.

2.5.3 Tolerances listed for parameters in Appendix B should not be confused with FSTD design tolerances and are the maximum acceptable for FSTD qualification.

2.5.4 The validation testing for initial and recurrent evaluations listed in Appendix B should be conducted in accordance with the FSTD type against approved data. An optional process for recurrent evaluation using MQTG results as reference data is described in Part II, Attachment H.

2.5.4.1 Where the fidelity level is S, the initial and recurrent evaluations should be based on objective evaluation against approved data. For evaluation of FSTDs representing a specific aeroplane type, 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 CAA responsible for the qualification. The tolerances listed in Appendix B are applicable for the initial evaluation.

Alternatively, the recurrent evaluation can be based on objective evaluation against MQTG results as described in Part II, Attachment H.

2.5.4.2 Where the fidelity level is R, the initial and recurrent validation will be based on objective evaluation against approved data for a class of aeroplane with the exception of aeroplane type specific FSTDs (sound and motion systems) where these evaluations are against aeroplane type-specific data. For initial evaluation of FSTDs representing a class of aeroplane, the aeroplane manufacturer's validation flight test data are preferred. Data from other sources may be used, subject to the review and concurrence of the CAA responsible for the qualification.

2.5.4.2.1 For motion and sound systems, where approved subjective development is submitted for the initial evaluation, the QTG should contain both:

a) the original objective test results showing compliance to the validation flight test data; and

b) the "improved" results, based upon approved subjective development against the validation flight test data. If approved subjective development is used, the MQTG result for those particular cases will become the reference data standard. Recurrent validations should be objectively measured against the reference data standard.

2.5.4.2.2 The tolerances listed in Appendix B are applicable for both initial and recurrent evaluations except where approved subjective development is used for motion and sound systems.

2.5.4.2.3 Alternatively, the recurrent evaluation can be based on objective evaluation against MQTG results as described in Part II, Attachment H.

2.5.4.3 Where the fidelity level is G, the initial validation will be based on evaluation against approved 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 Appendix B are applicable for recurrent evaluations and should be applied to ensure the device remains at the standard initially qualified.

2.5.5 Requirements for generic or representative FSTD data are defined below.

2.5.5.1 Generic or representative data may be derived from a specific aeroplane within the class of aeroplanes the FSTD is representing or it may be based on information from several aeroplanes within the class. With the concurrence of the CAA, it may be in the form of a 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 CAA, it will become the validation data that will be used as reference for subsequent recurrent evaluations with the application of the stated tolerances.

2.5.5.2 The substantiation of the set of data used to build validation data should be in the form of a "Reference Data" engineering report and should show that the proposed validation data are representative of the aeroplane or the class of aeroplanes modelled. This report may include flight test data, manufacturer's design data, information from the aeroplane flight manual (AFM) and maintenance manuals, results of approved or commonly accepted simulations or predictive models, recognized theoretical results, information from the public domain, or other sources as deemed necessary by the FSTD manufacturer to substantiate the proposed model.

2.5.6 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. However, the FSTD should be re-qualified following the release of the manufacturer's data obtained during the type certification of the aeroplane. The re-qualification schedule should be as agreed by the CAA, the FSTD operator, the FSTD manufacturer and the aeroplane manufacturer. For additional information, see Part II, Attachment A.

2.5.7 FSTD operators 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 manual. In this instance it may be necessary for an FSTD operator to acquire additional flight test data.

2.5.8 During FSTD evaluation, if a problem is encountered with a particular validation test, the test may be repeated to ascertain if test equipment or personnel error caused the problem. Following this, if the test problem persists, an FSTD operator should be prepared to offer alternative test results which relate to the test in question.

2.5.9 Validation tests which do not meet the test criteria should be satisfactorily rectified or a rationale should be provided with appropriate engineering judgement.

2.6 QUALIFICATION TEST GUIDE (QTG)

2.6.1 The QTG is the primary reference document used for the evaluation of an FSTD. It contains FSTD test results, statements of compliance and other information to enable the evaluator to assess if the FSTD meets the test criteria described in this manual.

2.6.2 The applicant should submit a QTG which includes:

a) a title page including (as a minimum) the

1) FSTD operator's name;

2) aeroplane model and series or class, as applicable, being simulated;

3) FSTD qualification level;

4) CAA FSTD identification number;

5) FSTD location;

6) FSTD manufacturer's unique identification or serial number; and

7) provision for dated signature blocks:

i) one for the FSTD operator to attest that the FSTD has been tested using a documented acceptance testing procedure covering flight deck layout, all simulated aeroplane systems and the Instructor Operating Station, as well as the engineering facilities, the motion, visual and other systems, as applicable.

ii) one for the FSTD operator to attest that all manual validation tests have been conducted in a satisfactory manner using only procedures as contained in the QTG manual test procedure;

iii) one for the FSTD operator to attest that the functions and subjective testing in accordance with Appendix C have been conducted in a satisfactory manner; and

iv) one for the FSTD operator and the CAA indicating overall acceptance of the QTG;

b) an FSTD information page providing (as a minimum):

   1) applicable regulatory qualification standards;

   2) the aeroplane model and series or class, as applicable, being simulated;

   3) the aerodynamic data revision;

   4) the engine model(s) and its(their) data revision(s);

   5) the flight control data revision;

   6) the avionic equipment system identification and revision level when the revision level affects the training and testing or checking capability of the FSTD;

   7) the FSTD manufacturer;

   8) the date of FSTD manufacture;

   9) the FSTD computer identification;

   10) the visual system type and manufacturer;

   11) the motion system type and manufacturer;

   12) three or more designated qualification visual scenes; and

   13) supplemental information for additional areas of simulation which are not sufficiently important for the CAA to require a separate QTG;

c) a table of contents to include a list of all QTG tests including all sub-cases, unless provided elsewhere in the QTG;

d) a log of revisions and/or list of effective pages;

e) a listing of reference and source data for FSTD design and test;

f) a glossary of terms and symbols used;

g) a statement of compliance (SOC) with certain requirements; SOCs should refer to sources of information and show compliance rationale to explain how the referenced material is used, applicable mathematical equations and parameter values and conclusions reached (see the "Comments" column of Appendices A and B for SOC requirements);

h) recording procedures and required equipment for the validation tests;

i) the following items for each validation test designated in Appendix B:

   1) *Test number*. The test number which follows the numbering system set out in Appendix B;

   2) *Test title.* Short and definitive, based on the test title referred to in Appendix B;

3) *Test objective*. A brief summary of what the test is intended to demonstrate;

4) *Demonstration procedure.* A brief description of how the objective is to be met. It 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;

5) *References.* References to the aeroplane data source documents including both the document number and the page/condition number and, if applicable, any data query references;

6) *Initial conditions.* A full and comprehensive list of the FSTD initial conditions;

7) *Test parameters.* A list of all parameters driven or constrained during the automatic test;

8) *Manual test procedures.* Procedures should be self-contained and sufficient to enable the test to be flown by a qualified pilot, by reference to flight deck instrumentation. 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;

9) *Automatic test procedures.* A test identification number for automatic tests should be provided;

10) *Evaluation criteria.* The main parameter(s) under scrutiny during the test;

11) *Expected result(s).* The aeroplane result, including tolerances and, if necessary, a further definition of the point at which the information was extracted from the source data;

12) *Test result*. FSTD validation test results obtained by the FSTD operator 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 CAA conducting the test;

    c) be time histories unless otherwise indicated and:

        i) should plot for each test the list of recommended parameters contained in the *Aeroplane Flight Simulator Evaluation Handbook*, Volume I (see Part II, Chapter 2, 2.3.3);

        ii) be clearly marked with appropriate time reference points to ensure an accurate comparison between FSTD and aeroplane;

        iii) the FSTD result and validation data plotted should be clearly identified; and

        iv) in those cases where a “snapshot” result in lieu of a time history result is authorized, the FSTD operator 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 Appendix B to Part II or III, as appropriate.

13) *Validation data*.

a) Computer-generated displays of flight test data overplotted with FSTD data should be provided. To ensure authenticity of the validation data, a copy of the original validation data, clearly marked with the document name, page number, the issuing organization and the test number and title as specified in 1) and 2) above, should also be provided;

b) 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; and

c) 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;

14) *Comparison of results.* The accepted means of comparing FSTD test results to the validation data is overplotting;

j) a copy of the applicable regulatory qualification standards, or appropriate sections as applicable, used in the initial evaluation, and

k) a copy of the validation data roadmap (VDR) to clearly identify (in matrix format only) sources of data for all required tests including sound and vibration data documents.

2.6.3 The QTG will provide the documented proof of compliance with the FSTD validation tests in Appendix B. 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 aeroplane data is essential to verify FSTD performance in each test. The evaluation serves to validate the FSTD test results given in the QTG.

2.7 MASTER QUALIFICATION TEST GUIDE (MQTG)

2.7.1 During the initial evaluation of an FSTD, the MQTG is created. This is the master document, as amended in agreement with the CAA, to which FSTD recurrent evaluation test results are compared.

2.7.2 After the initial evaluation, the MQTG is available as the document to use for recurrent or special evaluations and is also the document that any CAA can use as proof of an evaluation and current qualifications of an FSTD when approval for the use of the particular FSTD is requested for a specific training task.

2.8 ELECTRONIC QUALIFICATION TEST GUIDE (eQTG)

Use of an eQTG may reduce costs, save time and improve timely communication, and is becoming a common practice. ARINC Report 436 provides guidelines for an eQTG (see Part II, Chapter 2, 2.3.3).

2.9 QUALITY MANAGEMENT SYSTEM AND CONFIGURATION MANAGEMENT

2.9.1 A quality management system, which is acceptable to the CAA, should be established and maintained by the FSTD operator to ensure the correct maintenance and performance of the FSTD. The quality management system may be based upon established industry standards, such as ARINC Report 433 (see Part II, 2.3.3).

2.9.2 A configuration management system should be established and maintained to ensure the continued integrity of the hardware and software as from the original qualification standard, or as amended or modified through the same system.

2.10 TYPES OF EVALUATIONS

2.10.1 An initial evaluation is the first evaluation of an FSTD to qualify it for use. It consists of a technical review of the QTG and a subsequent on-site validation of the FSTD to ensure it meets all the requirements of this manual.

2.10.2 Recurrent evaluations are those that may be accomplished periodically to ensure that the FSTD continues to meet its qualification level.

2.10.3 Special evaluations are those that may be accomplished resulting from any of the following circumstances:

a) a major hardware and/or software change which may affect the handling qualities, performance or systems representations of the FSTD;

b) a request for an upgrade for a higher qualification level; and

c) the discovery of a situation that indicates the FSTD is not performing at its initial qualification standard.

Note.— Some of the above circumstances may require establishing revised tests leading to an amendment of the MQTG.

2.11 CONDUCT OF EVALUATIONS

Note.— The Manual on the Approval of Training Organizations *(Doc 9841) contains guidance on the recognition by other States of an FSTD qualification issued by a State, including for the initial qualification of an FSTD that already holds a qualification issued by another State*.

2.11.1 Initial FSTD evaluations

2.11.1.1 An FSTD operator seeking qualification of an FSTD should make the request for an evaluation to the CAA of the State in which the FSTD will be located.

2.11.1.2 A copy of the FSTD's QTG, with annotated test results, should accompany the request. Any QTG deficiencies raised by the CAA should be corrected prior to the start of the evaluation.

2.11.1.3 The request for evaluation should also include a statement that the FSTD has been thoroughly tested using a documented acceptance testing procedure covering flight deck layout, all simulated aeroplane systems and the instructor operating station as well as the engineering facilities, motion, visual and other systems, as applicable. In addition, a statement should be provided that the FSTD meets the criteria described in this manual. The applicant should further certify that all the QTG tests for the requested qualification level have been satisfactorily conducted.

2.11.2 Modification of an FSTD

2.11.2.1 An update is a result of a change to the existing device where it retains its existing qualification level. The change may be approved through a recurrent evaluation or a special evaluation if deemed necessary by the CAA, according to the applicable regulations in effect at the time of initial qualification.

2.11.2.2 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 CAA, clearly mean an improvement to the performance and training capabilities of the device altogether, then the CAA may accept the proposed change as an update while allowing the device to retain its original qualification level.

2.11.2.3 An upgrade is defined as the raising of the qualification level of a device, which can only be achieved by undergoing an initial qualification according to the latest applicable regulations.

2.11.2.4 In summary, as long as the qualification level of the device does not change, all changes made to the device should be considered to be updates pending approval by the CAA. An upgrade and consequent initial qualification according to latest regulations is only applicable when the FSTD operator requests a higher qualification level for the FSTD.

2.11.3 Temporary deactivation of a currently qualified FSTD

2.11.3.1 In the event an FSTD operator plans to remove an FSTD from active status for a prolonged period, the appropriate CAA should be notified and suitable controls established for the period the FSTD is inactive.

2.11.3.2 An understanding should be arranged with the CAA to ensure that the FSTD can be restored to active status at its originally qualified level.

2.11.4 Moving an FSTD to a new location

2.11.4.1 In instances where an FSTD is to be moved to a new location, the appropriate CAA should be advised of the planned activity and provided with a schedule of events related thereto.

2.11.4.2 Prior to returning the FSTD to service at the new location, the FSTD operator should agree with the appropriate CAA which of the validation and functional tests from the QTG should be performed to ensure that the FSTD performance meets its original qualification standard. A copy of the test documentation should be retained with the FSTD records for review by the appropriate CAA.

2.11.5 Composition of an evaluation team

2.11.5.1 For the purposes of qualification of an FSTD, an evaluation team is usually led by a pilot inspector from the CAA along with engineers and a type-qualified pilot.

2.11.5.2 The applicant should provide technical assistance in the operation of the FSTD and the required test equipment. The applicant should make available a suitably knowledgeable person to assist the evaluation team as required.

2.11.5.3 On an initial evaluation, the FSTD manufacturer and/or aeroplane manufacturer should have technical staff available to assist as required.

2.11.6 FSTD recurrent evaluations

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

2.11.6.2 The CAA having jurisdiction over the FSTD should establish the time interval between the recurrent evaluations.

2.12 ADOPTION OF THIS MANUAL INTO THE REGULATORY FRAMEWORK

The articulation of Volume I of this manual and its amendments into the regulatory framework is the responsibility of the various CAAs through national regulatory documents such as FAA 14 CFR Part 60, EASA CS-FSTD (A) or other equivalent document (see Part II, Chapter 2, 2.3.2).

2.13 FUTURE UPDATES OF THIS MANUAL

Part II, Appendix D describes the process to be used for proposed future updates to this manual.

2.14 EVALUATION HANDBOOKS

The *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 Royal Aeronautical Society (see Part II, Chapter 2, 2.3.3).

2.15 GUIDANCE ON “GRANDFATHERED” RIGHTS

2.15.1 The regulatory standards for the qualification of FSTDs will continue to develop to cater for: changing training needs; data revisions; relocations; the introduction of new equipment, procedures and technologies and mandated measures to address safety issues. The introduction of changes to the regulatory standards should not necessarily result in making existing qualified FSTDs obsolete. To enable accredited training to continue on them, "grandfathering" of the qualification should be applied. This allows continued training on the device provided it continues to meet the qualification standard achieved at its initial qualification.

2.15.2 When CAA’s implement these technical requirements into their regulations they should make provisions for the grandfathering of FSTDs that are in existence, on order, or under development. In addition, the regulations should include provisions to retroactively mandate certain updates that are considered important for aviation safety.

Appendix A

REQUIREMENTS FOR FEATURE FIDELITY LEVELS

INTRODUCTION

This appendix describes the methodology to create and test a bespoke device to meet specified training criteria, employing the training requirements and features defined in Part I. The validation tests and functions and subjective tests listed in Appendices B and C should also be consulted when determining the requirements for qualification. Certain requirements included in this appendix should be supported with a statement of compliance (SOC) and, in some designated cases, an objective test. The SOC should describe how the requirement was met, such as gear modelling approach, coefficient of friction sources, etc. In the following tabular listing of FSTD criteria, requirements for SOCs are indicated in the comments column.

1. REQUIREMENT — FLIGHT DECK LAYOUT AND STRUCTURE

1.	Feature General Requirement Flight Deck Layout and Structure	G	R1	R	S	Comments
1.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.**				✓	
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 approved 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 approved use.**	✓				

	Feature Technical Requirement Flight Deck Layout and Structure	G	R1	R	S	Comments
1.1	FLIGHT DECK STRUCTURE					
1.1.S.a	An enclosed, full scale replica of the flight deck of the aeroplane being simulated.				✓	For Training-to-Proficiency (TP): RL, RO, IO, CQ, TR, ATPL and MPL4. For Training (T): MPL4 and Re.
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.				✓	For Training (T): ATPL, TR, IO, RO and RL.
1.1.S.c (ctd next page)	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. 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 and/or required bulkheads.*				✓	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 not supported in the simulation software should be identified on the FSTD information page. Bulkheads containing only items such as landing gear pin storage compartments, fire axes or extinguishers, spare light bulbs, 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 CAA. 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.

	Feature Technical Requirement Flight Deck Layout and Structure	G	R1	R	S	Comments
1.1.S.c (ctd)						The use of electronically displayed images with physical overlay or masking for FSTD instruments and/or instrument panels is acceptable provided: — 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; — instruments displayed are free of quantization (stepping); — 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; — 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. For Training-to-Proficiency (TP): MPL4, TR, ATPL, RO, IO, CQ, and RL. For Training (T): MPL4 and Re only: – 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.

	Feature Technical Requirement Flight Deck Layout and Structure	G	R1	R	S	Comments
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 aeroplanes. *Note 1.— The flight deck enclosure need only be representative of that in the aeroplane or those in the class of aeroplanes being simulated and should include windows.* *Note 2.— The enclosure need only extend to the aft end of the flight deck.*			✓		FSTD instruments and/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 quantization (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 aeroplanes in a convertible FSTD. Each FSTD conversion should be representative of the aeroplane or class of aeroplanes being simulated which may require some controls, instruments, panels, masking, etc. to be changed for some conversions. For PPL, CPL and MPL1 (T) only: If the FSTD is used for VFR training, it should be a representation of the aeroplane or class of aeroplanes comparable to the actual aeroplane used for flight training.
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; and associated controls, assembled in a spatial manner to resemble that of the aeroplane or class of aeroplanes being simulated. The flight instrument panel(s) position and crew member seats should provide the crew member(s) a representative posture at the controls and design eye position. *Note.— If the FSTD is used for any VFR training credit, it should be fitted with a representation of a glare shield that provides the crew member(s) a representative design eye position comparable to that of the actual aeroplane used for training.*	✓				The assembled components should be compatible and function in a cohesive manner. FSTD instruments and/or instrument panels using electronically displayed 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 quantization (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 aeroplanes being simulated. If the FSTD is convertible, some may have to be changed for some conversions.*

	Feature Technical Requirement Flight Deck Layout and Structure	**G**	**R1**	**R**	**S**	**Comments**
1.2	SEATING					
1.2.1.S	Flight crew member seats should replicate those in the aeroplane being simulated.				✓	
1.2.1.R	Flight crew member seats should represent 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 aeroplanes.	✓				
1.2.2.S.a	In addition to the flight crew member seats, there should be one instructor station seat and two suitable seats for an observer and an authority inspector. The location of at least one of these seats should provide an adequate view of the pilots' panels and forward windows.				✓	For Training-to-Proficiency (TP): MPL4, TR, ATPL, RO, IO, CQ, and RL. For Training (T): MPL4 and Re only: – The authority may consider options to this requirement based on unique 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 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 two-hour training session.
1.2.2.S.b	In addition to the flight crew member seats, there should be one instructor station seat and two suitable seats for an observer and an authority inspector.				✓	For Training (T): TR, ATPL, RL, RO and IO only: – At least one seat should have a system to permit selective monitoring of all flight crew member and instructor communications.
1.2.2.R	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.			✓		
1.2.2.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	FLIGHT DECK LIGHTING					
1.3.S	Flight deck lighting should replicate that in the aeroplane.				✓	

	Feature Technical Requirement Flight Deck Layout and Structure	G	R1	R	S	Comments
1.3.R	Lighting environment for panels and instruments should be sufficient for the operation being conducted.			✓		
1.3.G	Lighting environment for panels and instruments should be sufficient for the operation being conducted.	✓				

2. REQUIREMENT — FLIGHT MODEL (AERO AND ENGINE)

2.	Feature General Requirement Flight Model (Aero and Engine)	G	R1	R	S	Comments
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, centre of gravity location and configuration to support the approved 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, centre of gravity and moments of inertia as a function of payload and fuel loading should be implemented.**				✓	***Note.— 2.1.S.f and 2.1.S.g are only required if the regulations mandate, or the FSTD operator wishes to conduct, training in stall recovery from beyond the critical angle of attack. If no full stall manoeuvres are conducted, these two features should not be required.***
2.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.**			✓		
2.G	**Aerodynamic and engine modelling, aeroplane-like, 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.**	✓				

	Feature Technical Requirement Flight Model (Aero and Engine)	G	R1	R	S	Comments
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, centre of gravity location and configuration to support the intended use.				✓	
2.1.S.b	Aerodynamic modelling, that includes, for aeroplanes issued an original type certificate after 30 June 1980, 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 aeroplane manufacturer.				✓	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.
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 Appendix B, section 3.3 and test 2.f (ground effect).
2.1.S.d	Aerodynamic modelling for the effects of reverse thrust on directional control.				✓	Tests required. See Appendix B, 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 models should simulate the aerodynamic degradation effects of ice accretion on the aeroplane lifting surfaces including 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 or aeroplane gross weight.				✓	Icing effects simulation models are only required for those aeroplanes authorized for operations in icing conditions. Icing simulation models should be developed to provide training in the specific skills required for recognition of ice accumulation and execution of the required response. Tests required. See Appendix B, test 2.i.1 (engine and airframe icing effects demonstration (aerodynamic stall)). Aeroplane OEM data or other acceptable analytical methods should be utilized to develop ice accretion models. Should data from other generic sources be used, this will not constitute specific data and as such does not qualify as specific simulation. SOC required. The SOC should describe the effects which provide training in the specific skills required for recognition of icing phenomena and execution of recovery. The SOC should include verification that these effects have been tested. The SOC should describe the source data and any analytical methods used to develop ice accretion models. Coordination with the CAA is recommended well in advance of an FSTD evaluation and QTG submission.

	Feature Technical Requirement Flight Model (Aero and Engine)	G	R1	R	S	Comments
2.1.S.f	Aerodynamic stall modelling that includes degradation in static/dynamic lateral-directional stability, degradation in control response (pitch, roll, yaw), uncommanded roll response or roll-off requiring significant control deflection to counter, apparent randomness or non-repeatability, changes in pitch stability, Mach effects and stall buffet, as appropriate to the aircraft type. The model should be capable of capturing the variations seen in stall characteristics of the aeroplane (e.g., the presence or absence of a pitch break).				✓	In view of the possible difficulties in obtaining data to support this feature, this aspect of the Specific criteria should be treated only as Representative (of that particular aeroplane type), unless flight test data is available. It should only be used when integrated with a Specific model of all pre-stall conditions and is therefore included in the S Category (see Part II, Attachment P, 1.1 for applicability). SOC required. The SOC should identify the sources of data used to develop the aerodynamics model. Of particular interest is a mapping of test points in the form of alpha/beta envelope plot for a minimum of flaps up and flaps down. For the flight test data, a list of the types of manoeuvres used to define the aerodynamics model for angle of attack ranges greater than the first indication of stall are to be provided per flap setting. The stall model should be evaluated by an SME pilot with knowledge of the cues necessary to accomplish the required training objectives and experience in conducting stalls in the type of aeroplane being simulated. The SME pilot conducting the stall model evaluation should be acceptable to the CAA and the aeroplane OEM. The SME pilot is also responsible for evaluating the other recognition cues (such as stall buffet, automation responses and control effectiveness).
2.1.S.g	The aerodynamics model should incorporate an angle of attack and sideslip range to support the training task. At a minimum, the model should support an angle of attack range to 10° beyond the critical angle of attack. The critical angle of attack is the point where the behaviour of the aeroplane gives the pilot a clear and distinctive indication through the inherent flight characteristics (see definition of stall) or the characteristics resulting from the operation of a stall identification device (e.g. a stick pusher) that the aeroplane is stalled.				✓	The FSTD should be capable of performing upset recognition and recovery tasks as defined by and agreed with the FSTD operator's CAA and the aeroplane OEM. (see Part II, Attachment, 1.1 for applicability). The FSTD should be evaluated for each specific upset recovery manoeuvre for the purpose of determining that the combination of angle of attack and sideslip does not exceed the range of validated data or wind tunnel/analytical data during a typical recovery manoeuvre as defined in the FSTD operator's training programme.
2.1.R	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, centre of gravity location and configuration.			✓		

	Feature Technical Requirement Flight Model (Aero and Engine)	**G**	**R1**	**R**	**S**	**Comments**
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, centre of gravity location and configuration.	✓				
2.2	MASS PROPERTIES					
2.2.S	Type-specific implementation of aeroplane mass properties, including mass, centre of gravity and moments of inertia as a function of payload and fuel loading. The effects of pitch attitude and of fuel slosh on the aeroplane centre of gravity 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 the effects of fuel slosh on centre of gravity.
2.2.R	N/A.					
2.2.G	N/A.					

3. REQUIREMENT — GROUND REACTION AND HANDLING CHARACTERISTICS

3.	Feature General Requirement Ground Reaction and Handling Characteristics	G	R1	R	S	Comments
3.S	Represents ground reaction and handling characteristics of the aeroplane during surface operations to support the approved use. Brake and tire failure dynamics (including antiskid) 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.				✓	
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.	✓				

	Feature Technical Requirement Ground Reaction and Handling Characteristics	G	R1	R	S	Comments
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 include strut deflections, tire friction, side forces, environmental effects 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.
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, tire 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.
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 Appendix B, test 1.e (stopping). Subjective tests for (4), (5) and (6). See Appendix C.

	Feature Technical Requirement Ground Reaction and Handling Characteristics	G	R1	R	S	Comments
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.			✓		
3.2.G	Stopping and directional control forces for dry runway conditions.	✓				
3.3	BRAKE AND TIRE FAILURES					
3.3.S	Brake and tire 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.
3.3.R	N/A.					
3.3.G	N/A.					

4. REQUIREMENT — AEROPLANE SYSTEMS (ATA)

4.	Feature General Requirement Aeroplane Systems (ATA Chapters)	G	R1	R	S	Comments
4.S	**Aeroplane systems should be replicated with sufficient functionality for flight crew operation to support the approved 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 approved use.** **System functionality should enable sufficient normal and appropriate abnormal and emergency operating procedures to be accomplished.**			✔		
4.G	**N/A.**					

	Feature Technical Requirement Aeroplane Systems (ATA Chapters)	G	R1	R	S	Comments
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 or original equipment manufacturer, or alternative approved 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 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 or original equipment manufacturer, or alternative approved 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.G	N/A.					

	Feature Technical Requirement Aeroplane Systems (ATA Chapters)	G	R1	R	S	Comments
4.2	CIRCUIT BREAKERS					
4.2.S	Circuit breakers that affect procedures and/or result in observable flight deck indications should be functionally accurate.				✓	
4.2.R	Circuit breakers that affect procedures and/or result in observable flight deck indications should be functionally accurate.			✓		Applicable if circuit breakers fitted.
4.2.G	N/A.					
4.3	INSTRUMENT INDICATIONS					
4.3.S	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.
4.3.R	All relevant instrument indications involved in the class of aeroplanes being simulated 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.
4.3.G	N/A.					
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.				✓	
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.			✓		
4.4.G	N/A.					
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 aeroplanes 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.
4.5.G	N/A.					

5. REQUIREMENT — FLIGHT CONTROLS AND FORCES

5.	Feature General Requirement Flight Controls and Forces	G	R1	R	S	Comments
5.S	**Control forces and control travel should correspond to that of the aeroplane to support the approved 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.**				✓	
5.R	**Aeroplane-like, derived from class, appropriate to aeroplane mass to support the approved use.** **Active force feedback required.**			✓		
5.R1	**Aeroplane-like, derived from class, appropriate to aeroplane mass to support the approved use.** **Active force feedback not required.**		✓			**For MPL1 (T) only.**
5.G	**Aeroplane-like to support the approved use.** **Active force feedback not required.**	✓				

	Feature Technical Requirement Flight Controls and Forces	G	R1	R	S	Comments
5.1	CONTROL FORCES AND TRAVEL					Testing of position versus force is not applicable if forces are generated solely by use of aeroplane hardware in the FSTD.
5.1.S.a	Control forces, control travel and surface position should correspond to that of the type-specific aeroplane being simulated. 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 aircraft equipped with a stick pusher system, control forces, displacement and surface position should correspond to that of the aeroplane being simulated. Control travel and forces should react in the same manner as in the aeroplane under the same flight and system conditions.				✓	SOC required. The SOC should verify that the stick pusher system/stall protection system has been modelled, programmed and validated using the aircraft manufacturer's design data or other approved data. The SOC should 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. See Appendix B, test 2.a.10 (stick pusher system force calibration).

	Feature Technical Requirement Flight Controls and Forces	**G**	**R1**	**R**	**S**	**Comments**
5.1.R	Control forces, control travel and surface position should correspond to that of the aeroplane or class of aeroplanes being simulated. Control travel, forces and surfaces should react in the same manner as in the aeroplane or class of aeroplanes under the same flight and system conditions.			✓		Active force feedback required if appropriate to the aeroplane installation.
5.1.R1	Control forces, control travel and surface position should correspond to that of the aeroplane or class of aeroplanes being simulated. Control surfaces should react in the same manner as in the aeroplane or class of aeroplanes under the same flight and system conditions, but control travel and forces should broadly correspond to the aeroplane or class of aeroplanes simulated.		✓			Active force feedback not required. For MPL1 (T) only.
5.1.G	Control forces, control travel and surface position should broadly correspond to the aeroplane or class of aeroplanes being 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 being simulated.				✓	See Part II, Appendix B, 3.2 for a discussion of acceptable methods of validating control dynamics. Tests required. See Appendix B, tests 2.b.1 through 2.b.3 (dynamic control checks).
5.2.R	N/A.					
5.2.G	N/A.					
5.3	CONTROL SYSTEM OPERATION					
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 flight deck indications and messages should be replicated.				✓	See Appendix C for applicable testing.
5.3.R, R1	Control systems should replicate the class of aeroplanes operation for the normal and any non-normal modes including back-up systems and should reflect failures of associated systems. Appropriate flight deck indications and messages should be replicated.		✓	✓		See Appendix C for applicable testing.
5.3.G	Control systems should allow basic aeroplane operation with appropriate flight deck indications.	✓				See Appendix C for applicable testing.

6. REQUIREMENT — SOUND CUES

6.	Feature General Requirement Sound Cues	G	R1	R	S	Comments
6.S	**N/A.**					
6.R	**Significant sounds perceptible to the flight crew during flight operations to support the approved use.** **Comparable engine, airframe and environmental sounds.** **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 approved use.** **Comparable engine and airframe sounds.**	✓				

	Feature Technical Requirement Sound Cues	G	R1	R	S	Comments
6.1	SOUND SYSTEM					
6.1.R	Significant 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.			✓		SOC required. For FSTDs used in UPRT: sounds associated with stall buffet should be replicated if significant in the aeroplane. Tests required. See Appendix B.
6.1.G	Significant flight deck sounds during normal and abnormal operations, aeroplane class-like, including engine and airframe sounds as well as those which result from pilot or instructor-induced actions.	✓				SOC required.
6.2	CRASH SOUNDS					
6.2.R	The sound of a crash when the aeroplane being simulated exceeds limitations.			✓		
6.2.G	The sound of a crash when the aeroplane being simulated exceeds limitations.	✓				
6.3	ENVIRONMENTAL SOUNDS					
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.	✓				

	Feature Technical Requirement **Sound Cues**	**G**	**R1**	**R**	**S**	**Comments**
6.4	SOUND VOLUME					
6.4.R	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 approved dataset. 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 IOS page which is always visible to the instructor.
6.4.G	The volume control should have an indication of sound level setting which meets all qualification requirements. Full volume should correspond to actual volume level agreed at 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.R	Sound should be directionally representative.			✓		SOC required.
6.5.G	Sound not required to be directional.	✓				

7. REQUIREMENT — VISUAL CUES

7.	Feature General Requirement Visual Cues	G	R1	R	S	Comments
7.S	**Continuous field of view with infinity perspective and textured representation of all ambient conditions for each pilot, to support the approved use.** **Horizontal and vertical field of view to support the most demanding manoeuvres requiring a continuous view of the runway.** **A minimum of 200° horizontal and 40° vertical field of view.**				✔	
7.R	**Continuous field of view with textured representation of all ambient conditions for each pilot, to support the approved use.** **Horizontal and vertical field of view to support the most demanding manoeuvres requiring a continuous view of the runway.** **A minimum of 200° horizontal and 40° vertical field of view.**			✔		
7.G	**A textured representation of appropriate ambient conditions, to support the approved use.** **Horizontal and vertical field of view to support basic instrument flying and transition to visual from straight-in instrument approaches.**	✔				

	Feature Technical Requirement Visual Cues	G	R1	R	S	Comments
7.1	DISPLAY					
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° horizontal and 40° vertical field of view. The system should be free from optical discontinuities and artefacts that create non-realistic cues.				✓	See Appendix B, test 4.a.1 (visual scene quality). An SOC is acceptable in place of this test. *Note.— Where the training task includes circling approaches with the landing on the reciprocal runway, a visual field of view in excess of 200° horizontal and 40° vertical would probably be required. Until such time as this becomes feasible the current arrangements in place with individual CAAs regarding approval for conducting specific circling approaches on a particular FSTD remain in place.*

	Feature Technical Requirement Visual Cues	G	R1	R	S	Comments
7.1.1.R	Continuous visual field of view providing each pilot with 200° horizontal and 40° vertical field of view.			✓		See Appendix B, test 4.a.1 (visual scene quality). Collimation is not required but parallax effects should be minimized (not greater than 10° 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. *Note.— Larger fields of view may be required for certain training tasks. The FOV should be agreed with the CAA.* 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° horizontally and 30° 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 Appendix B, test 4.a.1 (visual scene quality). 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 eyepoint.				✓	SOC required containing calculations confirming resolution. See Appendix B, test 4.a.3 (surface resolution).
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 eyepoint.			✓		SOC required containing calculations confirming resolution. See Appendix B, test 4.a.3 (surface resolution).
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 Appendix B, test 4.a.4 (light-point size).
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 Appendix B, test 4.a.4 (light-point size).
7.1.3.G	Suitable to support the intended use.	✓				

	Feature Technical Requirement Visual Cues	G	R1	R	S	Comments
7.1.4	DISPLAY CONTRAST RATIO					
7.1.4.S	Display contrast ratio — not less than 5:1.				✓	See Appendix B, test 4.a.5 (raster surface contrast ratio).
7.1.4.R	Display contrast ratio — not less than 5:1.			✓		See Appendix B, test 4.a.5 (raster surface contrast ratio).
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 Appendix B, test 4.a.6 (light-point contrast ratio).
7.1.5.R	Light-point contrast ratio — not less than 10:1.			✓		See Appendix B, test 4.a.6 (light-point contrast ratio).
7.1.5.G	Suitable to support the intended use.	✓				
7.1.6	LIGHT-POINT BRIGHTNESS					
7.1.6. S, R	Light-point brightness — not less than 20 cd/m^2 (5.8 ft-lamberts).			✓	✓	See Appendix B, test 4.a.7 (light-point brightness).
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/m^2 (5.8 ft-lamberts).				✓	See Appendix B, test 4.a.8 (surface brightness).
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/m^2 (4.1 ft-lamberts).			✓		See Appendix B, test 4.a.8 (surface brightness).
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 light valve projectors. An SOC should be provided if the test is not run, stating why. See Appendix B, test 4.a.9 (black level and sequential contrast).
7.1.8.R	Suitable to support the intended use.			✓		
7.1.8.G	Suitable to support the intended use.	✓				
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 pre-defined rate of movement across the image.				✓	A test is generally only required for light valve projectors. An SOC should be provided if the test is not run, stating why. See Appendix B, test 4.a.10 (motion blur).
7.1.9.R	Suitable to support the intended use.			✓		
7.1.9.G	Suitable to support the intended use.	✓				

	Feature Technical Requirement Visual Cues	G	R1	R	S	Comments
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 Appendix B, test 4.a.11 (speckle test).
7.1.10.R	Suitable to support the intended use.			✓		
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 each operation and phase of flight. An active display (repeater) of all parameters displayed on the pilot's combiner should be located on the instructor operating station (IOS), or other location approved by the CAA. Display format of the repeater should represent that of the combiner.				✓	See Appendix B, test 4.b (head-up display) and Part II, Attachment K.
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 instructor operating station (IOS), or other location approved by the CAA. Display format of the repeater should represent that of the combiner.			✓		SOC required. See Appendix B, test 4.b (head-up display) and Part II, Attachment K. Only the one 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). Image should be repeated on the IOS as for HUD requirement in 7.2.1.S herein. IOS weather presets should be provided for EFVS minimums.				✓	SOC required. See Appendix B, test 4.c (enhanced flight vision system) and Part II, Attachment L.

	Feature Technical Requirement Visual Cues	G	R1	R	S	Comments
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 Appendix B, test 4.c (enhanced flight vision system) and Part II, Attachment L. Only the one EFVS can be used by the pilot flying due to alignment display issues. Alternatively the EFVS may be presented as part of the visual scene.
7.2.2.G	N/A.					
7.3	VISUAL GROUND SEGMENT					
7.3.S	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 Appendix B, test 4.d (visual ground segment).
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 Appendix B, test 4.d (visual ground segment).
7.3.G	A demonstration of suitable visibility.	✓				

8. REQUIREMENT — MOTION CUES

8.	Feature General Requirement Motion Cues	G	R1	R	S	Comments
8.S	**N/A.**					
8.R	**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 the correct sensation to support the approved use.**			✓		
8.R.1	**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 approved 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.**		✓			
8.G	**N/A.**					

	Feature Technical Requirement Motion Cues	G	R1	R	S	Comments
8.1	MOTION CUES GENERAL					When motion systems have been added by the FSTD operator 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.
8.1.R.a	Motion cues (vestibular) in 6 DOF, as perceived by the pilot, should be representative of the motion of the aeroplane being simulated (e.g. touchdown cues should be a function of the rate of descent (R/D) of the aeroplane being simulated).			✓		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 motion of the aeroplane being simulated for upset recovery and stall training tasks.			✓		Reproduction of the aeroplane's sustained load factor associated with these manoeuvres is not required. SOC required.
8.1.R1.a	Motion cues (vestibular) in 6 DOF, as perceived by the pilot, should be representative of the motion of the aeroplane being simulated (e.g. touchdown cues should be a function of the R/D of the aeroplane being simulated).		✓			SOC required.

	Feature Technical Requirement Motion Cues	G	R1	R	S	Comments
8.1.R1.b	Motion cues (vestibular) in 6 DOF. The onset cues in the critical axes, as perceived by the pilot, should be representative of the motion of the aeroplane being simulated for upset recovery and stall training tasks.		✓			SOC required.
8.2	MOTION FORCE CUEING					
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).			✓		SOC required.
8.2.R1	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.
8.3	MOTION EFFECTS					
8.3.R (ctd next page)	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 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 Appendix C.
	(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/speedbrake extension and thrust reversal.			✓		
	(4) Bumps associated with the landing gear.			✓		
	(5) Buffet during extension and retraction of landing gear.			✓		
	(6) Buffet in the air due to flap and spoiler/speedbrake extension.			✓		
	(7) Buffet due to atmospheric disturbances, e.g. turbulence in three linear axes (isotropic).			✓		
	(8) Approach to stall buffet.			✓		If there are known flight conditions where buffet is the first indication of stall, or where no stall buffet occurs, this should be included in the model.

	Feature Technical Requirement Motion Cues	G	R1	R	S	Comments
8.3.R (ctd)	(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) Tire 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.			✓		
8.3.R1 (ctd next page)	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 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 Appendix C.
	(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/speedbrake extension and thrust reversal.		✓			
	(4) Bumps associated with the landing gear.		✓			
	(5) Buffet during extension and retraction of landing gear.		✓			
	(6) Buffet in the air due to flap and spoiler/speedbrake extension.		✓			
	(7) Buffet due to atmospheric disturbances, e.g. turbulence in three linear axes (isotropic).		✓			
	(8) Approach to stall buffet.		✓			
	(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.

	Feature Technical Requirement Motion Cues	G	R1	R	S	Comments
8.3.R (ctd)	(10) Nosewheel scuffing (if applicable).		✓			
	(11) Thrust effect with brakes set.		✓			
	(12) Mach and manoeuvre buffet.		✓			
	(13) Tire 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.R (ctd next page)	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 flight deck. The FSTD should be programmed and instrumented in such a manner that the characteristic vibration modes can be measured and compared to aeroplane data.			✓		See Appendix B, test 3f (characteristic motion vibrations). SOC required.
	(1) Thrust effects with brakes set.			✓		
	(2) Landing gear extended buffet.			✓		
	(3) Flaps extended buffet.			✓		
	(4) Speedbrake deployed buffet.			✓		
	(5) Stall buffet amplitude and frequency content.			✓		Modelling increase in buffet amplitude from initial buffet threshold of perception to critical angle of attack or deterrent buffet as a function of angle of attack. The stall buffet modelling should include effects of Nz, as well as Nx and Ny if relevant. The frequency content of the stall buffet should be representative of stall buffets for the aeroplane being simulated. Tests required. See Appendix B, test 2.c.8a (stall characteristics) and test 3.f.5 (stall buffet). Instrument vibrations should be replicated, if significant in the aircraft. Note related sound requirements in 6.1.R.

	Feature Technical Requirement Motion Cues	G	R1	R	S	Comments
8.4.R (ctd)	(6) High speed or Mach buffet.			✓		
	(7) In-flight vibrations.			✓		Propeller-driven aeroplanes only.
8.4.R1	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 flight deck. The FSTD should be programmed and instrumented in such a manner that the characteristic vibration modes can be measured.		✓			See Appendix B, test 3.f (characteristic motion vibrations). SOC required.
	(1) Thrust effects with brakes set.		✓			
	(2) Landing gear extended buffet.		✓			
	(3) Flaps extended buffet.		✓			
	(4) Speedbrake deployed buffet.		✓			
	(5) Approach to stall buffet.		✓			
	(6) High speed or Mach buffet.		✓			
	(7) In-flight vibrations.		✓			Propeller-driven aeroplanes only.

9. REQUIREMENT — ENVIRONMENT — ATC

9.	Feature General Requirement Environment — ATC	G	R1	R	S	Comments
	Note.— Requirements for simulated ATC environment in this section should not be treated as prescriptive for FSTD qualification at this time. See Part II, Attachment O I for guidance on the implementation of simulated ATC environment.					
9.S	**Simulated ATC environment in the terminal area, representative of real-world airport locations and operations, with visual and audio correlated ground, landing and departing other traffic of scalable flow intensity to support the approved training programme.** **Airborne and ground other traffic follow appropriate routes for the airport location and exhibit representative performance and separation. Other traffic may be influenced by weather, where this supports the training objectives.** **ATC communications are consistent with other traffic movements. Where training requires, ATC radio communications reflect location-specific procedures and nomenclature. Other traffic may also be visually correlated with cockpit instrument displays such as TCAS and ADS-B.** **Flight crew and ATC-initiated standard radio communications to the ownship are simulated, including data link communications where required by the training objectives. All simulated ATC communications are in English and should adhere to ICAO standard phraseology (as per Doc 4444, PANS-ATM).** **Automated ATC communications to the ownship are not expected during abnormal or emergency conditions, or for airspace regions beyond terminal areas, where the instructor may manually provide the ATC service.**				✓	
9.G	**Simulated ATC environment in the terminal area, representative of generic or real-world airport locations and operations, with visual (where available) and audio correlated ground, landing and departing other traffic of sufficient flow intensity to support the approved training programme.** **Airborne and ground other traffic follow appropriate routes and exhibit representative performance and separation.** **ATC communications are consistent with other traffic movements.**	✓				

9.	**Feature General Requirement Environment — ATC**	**G**	**R1**	**R**	**S**	**Comments**
	Flight crew and ATC-initiated standard radio communications to the ownship are simulated. All simulated ATC communications are in English and should adhere to ICAO standard phraseology (as per Doc 4444, PANS-ATM). **Automated ATC communications to the ownship are not expected during abnormal or emergency conditions, or for airspace regions beyond terminal areas, where the instructor may manually provide the ATC service.**					

	Feature Technical Requirement Environment — ATC	**G**	**R1**	**R**	**S**	**Comments**
9.1	AUTOMATED WEATHER REPORTING					While automated terminal information service (ATIS) is the most common automated weather reporting system, other weather broadcast systems only need to be simulated where required by the training objectives.
9.1.1.S,G	Instructor control. The instructor has the ability to change the automated weather reporting message(s) from the IOS. The instructor should have the ability to override each value of any automated weather message.	✓			✓	
9.1.2.S	Automated weather reporting (multiple stations). In addition to the requirements detailed in 9.1.2.G below, the system should have the capability of generating more than one automated weather reporting message.				✓	Support for multiple station weather reporting broadcasts allows flight crews to listen simultaneously to concurrent automated weather reporting messages from different airports. The instructor may associate a particular automated weather reporting message to one or more airports, as necessary for the training session.
9.1.2.G	Automated weather reporting (single station). A single automated weather reporting message is required for all airports necessary for the training session. If the instructor makes a change to the message, it need not influence the weather conditions set in the FSTD. Conversely, the message need not change if the instructor changes the weather conditions set in the FSTD.	✓				The message should contain, at a minimum, the required elements of the weather reporting station type. This should include, but not be limited to, the following: airport, reference runway, temperature, wind, altimeter setting, clouds, visibility and runway conditions as well as predefined other conditions (such as transition level). Different stations will contain airport-specific information within the message, but the elements of the message that relate to weather conditions will be uniform across all messages.

	Feature Technical Requirement Environment — ATC	G	R1	R	S	Comments
9.1.3.S	Message format and regional characteristics. Messages should conform to either standard ICAO specifications or regional formats where relevant to the training objectives.				✓	The format and content of automated weather reporting messages may vary depending on location. Differences may include message content order, units, languages, etc. The training provider should determine the level of fidelity required for regional characteristics, where relevant to the training objectives.
9.1.3.G	ICAO message format. The format and content of automated weather reporting messages adhere to standard ICAO specifications (in accordance with Annex 11 — *Air Traffic Services*).	✓				
9.1.4.S	Provided by data link. Data link simulation may support text- and graphically-based weather services where required by the training objectives. Data link weather messages should correlate with the simulated environment. These messages may include; terminal weather information for pilots (TWIP), data link ATIS (D-ATIS), SIGMET, aerodrome routine meteorological report (METAR), notice to airmen (NOTAM), terminal aerodrome forecast (TAF) or others.				✓	D-ATIS is a text-based, digitally transmitted version of the ATIS audio broadcast. It is accessed via a data link service and can be displayed to the flight crew in the cockpit, commonly incorporated on the aircraft as part of a system such as an EFB or an FMS.
9.2	OTHER TRAFFIC Other traffic includes aeroplanes other than the ownship in the simulated environment, both airborne and on the ground. Other aircraft are part of the wider traffic context and may perform actions such as pushback, taxi, take-off and landing. Other traffic may also include ground vehicles where required to achieve specific training objectives.					Other traffic that can be seen and heard will help provide added realism to all flight phases, aid situational awareness, and add to the cognitive workload of the flight crew. Emphasis should be on a configurable system that supports key training objectives, rather than representation of real-world operations.
9.2.1.S	Aircraft behaviour (airport-specific). In addition to the requirements detailed in 9.2.1.G below, ground aircraft movement and gate/stand allocation should be airport-specific.				✓	To enhance the airport scene for added realism, other aircraft should adhere to type-appropriate taxi routes, gates, and parking stands. Specific airlines may be assigned to certain areas on the airport that generally reflect real-world operations.
9.2.1.G (ctd next page)	Aircraft behaviour. Airborne and ground aircraft follow appropriate routes and exhibit representative performance characteristics.	✓				At a minimum, landing and departing aircraft should use major taxiway routes. This traffic should be fully automated and also largely non-intrusive in order to minimize the need for instructor management. Traffic should exhibit representative type performance characteristics, in order not to demonstrate obviously erroneous behaviours.

	Feature Technical Requirement Environment — ATC	G	R1	R	S	Comments
9.2.1.G (ctd)						Ground traffic should, in general, adhere to standard rules and procedures in order not to create a distraction for the flight crew. At a minimum, ground traffic should follow typical speed restrictions and runway holding point procedures.
9.2.2.S	Airport clutter. Airport ground clutter does not need to have an active radio presence, unless this includes other traffic undertaking ground manoeuvres that would typically necessitate communication with ATC. Simulated ATC environment should control other traffic with an ATC radio presence.				✓	Airport clutter is pre-scripted ground traffic added only for realism in order to create a sense of movement in the airport scene. It will often perform repeated actions, and typically includes baggage carts, ground personnel, and service vehicles. Clutter may also include other stationary aircraft or other aircraft undertaking ground movements. This traffic generally moves in areas where the ownship is not expected and as such should be non-intrusive.
9.2.3.S	Traffic flow and separation (scalable). In addition to the requirements detailed in 9.2.3.G below, the intensity of other traffic in the simulated environment should be scalable by the instructor during a training session, where required by the training objectives.				✓	Several distinct traffic intensity levels, such as low/medium/high, should be provided along with instructor control during the training session. As a practical guide, appropriate traffic intensity levels for the reference runway may fall within the following three levels (these figures are a guide and should not be considered a requirement for training approval or device qualification): — Low: Approximately 10 other traffic movements per hour (local-, regional-, low-capacity needs airport). — Medium: Approximately 15 other traffic movements per hour (regional-, medium-capacity needs airport). — High: Approximately 30 other traffic movements per hour (major-, high-capacity needs airport). Other traffic, in addition to that using the reference runway, may be added to enhance the airport scene and create a busy traffic environment, where this supports the training objectives.
9.2.3.G	Traffic flow and separation. Traffic flow should be of sufficient intensity to accomplish the training objectives. Other traffic separation times/distances and minimum wake vortex separation criteria should be representative of the real world.	✓				

	Feature Technical Requirement Environment — ATC	**G**	**R1**	**R**	**S**	**Comments**
9.2.4.S	Traffic type (airport specific). Other aircraft types should be representative of operations at the airport location.				✓	
9.2.5.S,G	Traffic call sign and livery. Other aircraft call signs and livery should be representative of their operator.	✓			✓	Other aircraft should have allocated call signs and livery representative of their operator so that audio and visual cues to the flight crew are correlated.
9.2.6.S	Runway incursion. Where training requires, the instructor has the ability to trigger runway incursion threats.				✓	In order to achieve a particular training objective (e.g., rejected take-off or go-around training), the instructor has the ability to cause other aeroplanes or vehicles to create a conflict with the ownship on the runway.
9.2.7.S	Ownship priority. In addition to the requirements detailed in 9.2.7.G below, the instructor should also have the capability to give precedence to and/or promote the ownship with respect to other traffic.				✓	Precedence for the ownship during ground manoeuvres or while airborne will enable the instructor to force behaviour or removal from the scenario of other traffic in order to facilitate expedited passage of the ownship. Promotion of the ownship will enable the instructor to reposition the ownship at any location within a queue on the ground or traffic pattern in the airspace environment. These features concern training efficiency and are intended to save non-productive FSTD time, rather than enhance realism. As such, they should not be considered a requirement for training approval or device qualification.
9.2.7.G	Ownship priority (other traffic removal). The instructor should have the capability to remove any other traffic impeding the flow of the training scenario.	✓				This feature concerns training efficiency and is intended to save non-productive FSTD time, rather than enhance realism. As such, it should not be considered a requirement for training approval or device qualification.
9.3	BACKGROUND RADIO TRAFFIC					Background radio traffic (also known as party line or background chatter) concerns communications not addressed to the ownship heard on the flight deck. The simulation of radio communications other than those involving ATC is not required. Where beneficial for specific training purposes, non-ATC communications (such as operations, company, or aeroplane-to-aeroplane) may be delivered by other means. Realistic contextual background radio traffic will help to enhance the flight crew's situational awareness of their position in relation to other traffic (both airborne and on the ground). Simulated radio traffic should not be unintentionally distracting to the flight crew where it could negatively impact on training.

	Feature Technical Requirement Environment — ATC	**G**	**R1**	**R**	**S**	**Comments**
9.3.1.S,G	Background radio traffic. In general all background radio traffic should meet the following criteria: (1) communications should make sense within the context of the simulation environment and should not contain obviously erroneous information; (2) only messages relevant to the purpose of a given frequency should be heard on that frequency; (3) simulated communications on a given frequency should not normally step over one another or over those from the flight crew; and (4) reasonable pauses should be provided between communication exchanges to allow the flight crew access to the frequency.	✓			✓	
9.3.2.S	Other traffic radio communications (intrusive). In addition to the requirements detailed in 9.3.2.G below, intrusive background radio traffic should also be available where required by the training objectives.				✓	Other traffic radio communications can be considered “intrusive” if the transmission pertains to some aspect of the training evolution; that is, if the flight crew has to give consideration either to a radio transmission or behaviour exhibited by another aeroplane because it may affect the ownship, it can be considered “intrusive”. Intrusive other traffic is likely to be in close proximity to the ownship at times, and communications should be correlated with both out-the-window and on-board aircraft displays for all flight phases.
9.3.2.G	Other traffic radio communications (non-intrusive). Non-intrusive background radio traffic should be available. The intensity of radio traffic communications should be generally consistent with the traffic intensity.	✓				Non-intrusive radio traffic can be considered extraneous communication that is included only to improve the realism of the training experience. Non-intrusive other traffic is unlikely to be seen by the flight crew, particularly while airborne, either out the window or via on board aircraft displays. However, if it were to become visible to the flight crew in the real-world environment, it should be presented in the FSTD (that is, correlated with visual and on board display systems). Non-intrusive background radio traffic is intended to be a higher fidelity replacement to traditional “background chatter” in FSTDs.
9.3.3.S	ATC radio communications (location specific). In addition to the requirements detailed in 9.3.3.G below, location-specific ATC procedures and nomenclature should be accurately reflected in communications, where training requires.				✓	

	Feature Technical Requirement Environment — ATC	G	R1	R	S	Comments
9.3.3.G	ATC radio communications. ATC and other traffic initiated communications are consistent with other traffic movements, continuous across sector boundaries, and comply, where possible, with ICAO standard phraseology (as per Doc 4444, PANS-ATM).	✓				The system should support both ATC and other traffic initiated standard ATC radio communications. Communications should maintain continuity across ATC sector boundaries. Transmissions should comply, where possible, with the ATC radio communication phraseologies detailed in Doc 4444, PANS-ATM, Chapter 12, under the following categories (where appropriate to the training): i. General ii. Area control services iii. Approach control services iv. Vicinity of the aerodrome v. Phraseologies for use on or in the ATS surveillance service vi. Radar in approach control service vii. Secondary surveillance radar (SSR) and automatic dependent surveillance-broadcast (ADS-B) phraseologies viii. General automatic dependent surveillance-contract (ADS-C) phraseologies.
9.3.4. S,G	Overstepping on frequency. Flight crew overstepping on other traffic radio transmissions should cause a basic ATC notification. The instructor should have an indication of the overstepping event at the IOS.	✓			✓	In real-world operations, overstepping can occur when more than one transmitter transmits concurrently on the same radio frequency. The experience of the flight crew and any ATC resolution of this situation may vary depending on a number of factors. In order to best support the flow of training, re-broadcast of other traffic and ATC radio transmissions that have been overstepped by the flight crew is not required. The scope of this feature is not required to extend to other traffic or ATC overstepping on flight crew transmissions, or simulating ATC resolution of a prolonged blocking of the control frequency by the flight crew.
9.4	AIRPORT AND AIRSPACE MODELLING					The fidelity, detail and scope of the modelled airport and terminal area airspace need only to be adequate enough to meet the training objectives. It is recommended that the scope of airport/airspace modelling (for either a generic or specific modelled area) is best determined by the training provider.

	Feature Technical Requirement Environment — ATC	**G**	**R1**	**R**	**S**	**Comments**
9.4.1.S	Simulated ATC environment modelled areas (specific). The system should include a minimum of one specific airport model with associated terminal area and two additional generic, or higher fidelity, airports with associated terminal areas that are part of the approved training programme.				✓	It is necessary for simulated ATC environment to be implemented at multiple airport locations in order to facilitate LOFT type training scenarios. Non-real-world generic airport and airspace models should broadly reflect ICAO standards for aerodrome and airspace design (as outlined in Doc 8168, PANS-OPS and Doc 4444, PANS-ATM).
9.4.1.G	Simulated ATC environment modelled areas (generic). The system should include a minimum of two generic real-world or non-real-world airport models with associated terminal areas that are part of the approved training programme.	✓				Non-real-world generic airport and airspace models should broadly reflect ICAO standards for aerodrome and airspace design (as outlined in Doc 8168, PANS-OPS and Doc 4444, PANS-ATM).
9.4.2.S	Runways (multiple). In addition to the requirements detailed in 9.4.2 G below, other traffic movements on more than one runway are supported, where training requires, and the real-world airport has multiple runways.				✓	Although desirable to enhance the airport scene and for specific training scenarios (for example, runway incursion training), other traffic need not use more than one runway at the same time. Where specific airports are simulated, real-world operational limitations are reflected in the background traffic patterns.
9.4.2.G	Runways (single). Other traffic movements on a single runway in both directions are supported.	✓				Other traffic movements may include the following modes: take-off only, landing only, or both take-off and landing on the reference runway in either direction at a given time.
9.4.3.S,G	Data synchronization. Other traffic behaviours and radio communications are consistent with the airport model and airspace data used by the FSTD.	✓			✓	
9.5	WEATHER					
9.5.1.S,G	Reference runway. Other traffic behaviour should be determined by and consistent with the reference runway.	✓			✓	Other traffic behaviour, such as the direction of take-off and landing and the departure and arrival routing, should be determined by and consistent with the reference runway selected in the FSTD.
9.5.2.S	Other traffic separation. Other traffic separation is representative of real-world operations and correlates with the weather set at the airport location.				✓	
9.5.3.S	Low visibility operations. Where low visibility operations training is required, other traffic movements should respect low visibility procedures at the airport location.				✓	This functionality is only required at modelled airports that support low visibility training.

	Feature Technical Requirement Environment — ATC	G	R1	R	S	Comments
9.6	ATC — OWNSHIP COMMUNICATIONS					The method of delivery of simulated ATC communications to the ownship is not prescribed. It should be noted that a fully automated synthetic ATC service is not mandated. Where automated methods are used to simulate the majority of communications, it is not expected that all communications be automated.
9.6.1.S,G	Time synchronization. ATC communications (including automated weather reporting) that involve a reference to time should be correlated with the time displayed in the FSTD.	✓			✓	The system should have the capability of aligning ATC communications and weather reporting messages with the simulated time in the FSTD.
9.6.2.S,G	ATC radio communications. The system supports standard communications to and from the ownship. Communications should maintain continuity across ATC sector boundaries. Transmissions should comply with the phraseologies detailed in Doc 4444, PANS-ATM (Chapter 12). Where the ownship is transitioning between terminal areas, a continual ATC service is required at a level adequate to meet the training objectives. It is not expected that ATC communications to the ownship will be automatically simulated during abnormal and emergency conditions or for airspace regions beyond terminal areas.	✓			✓	The system should support both ATC and flight crew-initiated standard ATC radio communications to and from the ownship. The ATC service to the ownship may be provided manually by the instructor, however this method is not recommended for all communications, as it distracts the instructor from the primary task of observation.
9.6.3.S	Message triggering (automatic). Messages to the ownship can be automatically triggered during a training session.				✓	ATC messages to the ownship may be generated by a number of methods, such as from the lesson plan or by an instructor action at the IOS. This feature may require an override and/or mute function so that the instructor has control over automated messages and/or can revert back to manual delivery of ATC communications.
9.6.3.G	Message triggering (manual). The instructor should be able to manually trigger ATC messages to the ownship during a training session. Transmissions to the ownship should occur using the same ATC voices used to simulate background radio communications.	✓				Of paramount importance is that the workload of the instructor should be kept to a minimum. As such, automation and user-interface enhancements that can help to minimize the instructor's workload in this area are highly desirable.
9.6.4. S,G	"Standby" and "say again". Basic standby responses and requests for repeated information from ATC and the flight crew are supported.	✓			✓	
9.6.5. S,G	Readback and acknowledgements. Basic readback and acknowledgement errors from the flight crew should be corrected by ATC.	✓			✓	

	Feature Technical Requirement Environment — ATC	**G**	**R1**	**R**	**S**	**Comments**
9.6.6.S	Clearance deviations. Where training requires, ownship deviations from clearances or instructions should generate a response from ATC to the flight crew. The system should allow the instructor the option to intervene manually in such an event.				✓	Ownship deviations may include not respecting assigned speed, heading or altitude when airborne, or deviating from a cleared routing when on the ground.
9.7	LANGUAGE AND PHRASEOLOGY					
9.7.1. S,G	English. All communications are conducted as per Doc 4444, PANS-ATM.	✓			✓	
9.7.2. S,G	Standard phraseology. All simulated ATC radio transmissions to the ownship and between ATC and other traffic should, where possible, adhere to ICAO standard phraseology (as per Doc 4444, PANS-ATM).	✓			✓	It is of utmost importance that simulated ATC radio communications reinforce the correct use of standard phraseology. Adherence to ICAO standard phraseology may not always be achieved where the instructor manually provides the ATC service to the ownship.
9.8	OWNSHIP RADIO OPERATION					
9.8.1. S,G	Multi-frequency radio operation. Each pilot has the ability to select and listen to at least one radio frequency. The system supports multiple radios being operated concurrently.	✓			✓	Example: The pilot flying may listen to ATIS on VHF 1 while the pilot monitoring waits for clearance delivery on VHF 2.
9.9	SYSTEM CORRELATION					
9.9.1. S,G	Visual system. Where a visual display system is present, it should present other traffic correlated with simulated ATC environment.	✓			✓	Where an FSTD offers a visual display system, the flight crew should expect to see other traffic movements correlated with the simulated ATC environment. Visual correlation is required in order to maintain continuity between visual and audio cues for the flight crew.
9.9.2.S	TCAS. Where training requires, other traffic should become visible on the TCAS display and be able to trigger appropriate warnings when in close proximity to the ownship. Other traffic is not required to take evasive action or follow correct TCAS protocols.				✓	Short-term pre-scripted TCAS training scenarios are not required as part of the simulated ATC environment. Other traffic is not required to take evasive action or follow correct TCAS protocols in the case where ownship manoeuvres have triggered a TCAS advisory.
9.9.3.S	Cockpit traffic displays. Where training requires and where the ownship is equipped, other traffic becomes visible on cockpit displays such as ADS-B, ADS-R and TIS-B. Other traffic is not expected to exhibit self-managing behaviours other than basic navigation along pre-defined routes.				✓	If the training requires other traffic to be represented, cockpit display systems should be correlated with the FSTD visual display, radio communications and on the IOS. As with TCAS, the primary training benefit of this will be that the ownship flight crew is able to identify and manage threats from surrounding traffic.

	Feature Technical Requirement Environment — ATC	G	R1	R	S	Comments
9.9.4.S,G	IOS. The instructor should have access to basic information regarding other traffic and visibility of the wider traffic context.	✓			✓	The instructor should have access to basic information regarding other traffic on the IOS, as necessary to support training, such as call sign, aircraft type and basic flight plan details. The IOS should also include a situational display showing ownship and other traffic.
9.10	DATA LINK COMMUNICATIONS The simulation of data link communications is only required where necessary to support training objectives. Use of data link communications is not anticipated for MPL 1, 2 or 3. MPL 4 training objectives may require implementation of some data link features.					Data link communications that are unrelated to ATC (such as company communications and e-mail services) may be simulated where deemed beneficial for training, but are not required. If data link is used to replace voice communication, the fidelity of ATC data communications should match that of voice communications.
9.10.1.S	ATS clearances. ATS clearance messages are supported and should be consistent with published routes, waypoints, flight information regions and real-world ATC centres. Clearances should be consistent with clearances available from corresponding real-world ATC service providers.				✓	
9.10.2.S	ATS weather messages. ATS weather messages are supported and should be correlated with simulated weather conditions. Text reports should be consistent with information available via other automated weather reporting services and, if appropriate, correspond to visual cues and weather instrument displays.				✓	
9.10.3.S	Data link initiation capability (DLIC). DLIC is supported and allows the flight crew to establish a connection with a controller-pilot data link communications (CPDLC) service provider that corresponds to a real-world air traffic service unit. The four character ICAO identifier of the unit (see Doc 7910 — *Location indicators*) for CPDLC should correspond to its respective simulated region as described by the ICAO Global Operational Data Link Document (GOLD) or any other current, published standard.				✓	
9.10.4.S	Connection management. The system supports transferring and terminating data link connections, including CPDLC and ADS-C. The system should simulate the transfer between an active data service provider and the next data service provider at the appropriate time and/or distance from a control boundary. The system should support termination of a data link connection by the flight crew or simulated ATC service provider.				✓	

	Feature Technical Requirement Environment — ATC	G	R1	R	S	Comments
9.10.5.S	CPDLC. The system supports a CPDLC message set sufficient to deliver the training objectives. The flight crew is able to send, receive and display CPDLC messages supported by the hardware platform. CPDLC messaging should be consistent with regional protocols, using the message set available for the corresponding active data authority. Messages should result in correct cockpit visual and/or audio indications.				✓	
9.10.6.S	ADS-C. The system supports the provision of all ADS-C messages sufficient to deliver the training objectives. The ADS-C simulation should result in correct cockpit visual indications. ADS-C should only be available through simulated real-world service providers that support ADS-C messaging.				✓	
9.10.7.S	AOC/DSP. AOC messages may be supported as required by the training objectives. DSP messages may be supported by the system if they serve as the communication medium for ATS clearance and weather messages. Other DSP messages fall outside of the scope of simulated ATC environment.				✓	The simulation of AOC is generally outside of the scope of simulated ATC environment, as AOC are usually company-specific.
9.10.8.S	Service failures. The system should be able to simulate service failures and recovery, including CPDLC service failures, as required by the training objectives. The instructor should have control over inducing a service failure.				✓	A data link service failure generally describes instances where lost messages, time delays or network failures result in improper system operation.
9.11	ATC VOICE CHARACTERISTICS					The generation of radio communications may be achieved manually or automated using synthetic speech technologies. Where the latter is used, the focus should be on achieving realistic voice audio delivered from ATC services over those from other entities. In order to prevent unnecessary confusion to the flight crew, an ATC voice should not be re-assigned to another function (such as a pilot) within the same training session.
9.11.1.S	Voice assignment (multiple). Multiple voices should be assigned to the ATC function.				✓	The number of voices should be sufficient to allow differentiation of the various ATC services.
9.11.1.G	Voice assignment. At least one voice should be assigned to the ATC function.	✓				The voices used need only be diverse enough to avoid confusion between ATC services and other functions.

	Feature Technical Requirement Environment — ATC	G	R1	R	S	Comments
9.11.2.S	Gender and accents. Where possible, gender mix and regional or international accents should be used for ATC services broadly to reflect the airport or geographical location.				✓	It may not be practical or cost effective to incorporate specific gender and regional or international accents; however, the aim should be that the background radio traffic broadly reflects ATC services.
9.12	INSTRUCTOR CONTROLS					
9.12.1. S,G	Access to radio communications. The instructor should have the ability to communicate directly with the flight crew for training and instruction, and have access to flight crew and ATC radio communications for monitoring and communicating.	✓			✓	
9.12.2. S,G	FSTD functions. The system should be able to accommodate the most common FSTD functions, such as total/flight freeze, resets and repositions.	✓			✓	
9.12.3. S,G	Disable. The system should provide the instructor with the ability to disable all simulated ATC environment functionality.	✓			✓	It is desirable that the system support the case where an instructor wishes to provide ATC services to the ownship manually, but also desires that other traffic be simulated, along with associated background radio traffic.
9.12.4. S,G	Mute (background radio traffic). Background radio traffic audio output can be muted and then unmuted by the instructor.	✓			✓	While mute is enabled, the system should support continued background traffic simulation in real-time in order to minimize the impact on the wider traffic context and flight crew situational awareness.
9.12.5.S	Other training tools. Where applicable, it is desirable that simulated ATC environment support IOS-based lesson plans, debrief applications, and scenario development tools and applications.				✓	These features concern training efficiency and are intended to support training provision, rather than enhance realism. As such, they should not be considered necessary for training approval or device qualification.

10. REQUIREMENT — ENVIRONMENT — NAVIGATION

10.	**Feature General Requirement Environment — Navigation**	**G**	**R1**	**R**	**S**	**Comments**
10.S	**Navigational data with the corresponding approach facilities to support the approved use.** **Navigation aids should be usable within range or line-of-sight without restriction, as applicable to the geographic area.**				✔	
10.R	**N/A.**					
10.G	**N/A.**					

	Feature Technical Requirement Environment — Navigation	**G**	**R1**	**R**	**S**	**Comments**
10.1	NAVIGATION DATABASE					
10.1.S	Navigation database sufficient to support simulated aeroplane systems for real-world operations.				✓	
10.1.R	N/A.					
10.1.G	N/A.					
10.2	MINIMUM AIRPORT REQUIREMENT					
10.2.S	Complete navigation database for at least three airports with corresponding precision and non-precision approach procedures, including regular updates.				✓	Regular updates means navigation database updates as mandated by the CAA.
10.2.R	N/A.					
10.2.G	N/A.					
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.
10.3.R	N/A.					
10.3.G	N/A.					
10.4	ARRIVAL/DEPARTURE FEATURES					
10.4.S	Navigational data with all the corresponding standard arrival and departure procedures.				✓	
10.4.R	N/A.					
10.4.G	N/A.					
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.
10.5.R	N/A.					
10.5.G	N/A.					

11. REQUIREMENT — ENVIRONMENT — ATMOSPHERE AND WEATHER

11.	**Feature General Requirement Environment — Atmosphere and Weather**	**G**	**R1**	**R**	**S**	**Comments**
11.S	**N/A.**					
11.R	**Fully integrated dynamic environment simulation including a representative atmosphere with weather effects to support the approved 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 approved use.** **The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity.**	✓				

	Feature Technical Requirement Environment — Atmosphere and Weather	**G**	**R1**	**R**	**S**	**Comments**
11.1	STANDARD ATMOSPHERE					
11.1.S	N/A.					
11.1. R,G	Simulation of the standard atmosphere including instructor control over key parameters.	✓		✓		
11.2	WIND SHEAR					
11.2.S	N/A.					
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.			✓		See Appendix B, test 2.g (wind shear). 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 Royal Aeroplane Establishment (RAE) *Wind Shear Training*, the *Joint Airport Weather Studies (JAWS) Project* and other recognized 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 for recognition of wind shear phenomena.	✓				A subjective test is required. See Appendix C for similar examples.

	Feature Technical Requirement Environment — Atmosphere and Weather	**G**	**R1**	**R**	**S**	**Comments**
11.3	WEATHER EFFECTS					
11.3.S	N/A.					
11.3.R	The following weather effects as observed on the visual system should be simulated and respective instructor controls provided.			✓		A subjective test is required. See Appendix C for similar examples.
	(1) Multiple cloud layers with adjustable bases, tops, sky coverage and scud effect.			✓		Not required for IR and MPL2 (T).
	(2) Storm cells activation and/or deactivation.			✓		Not required for IR and MPL2 (T).
	(3) Visibility and runway visual range (RVR), including fog and patchy fog effects.			✓		Objective test required. See Appendix B, test 4.d (visual ground segment). Not required for IR and MPL2 (T).
	(4) Effects on ownship external lighting.			✓		Not required for IR and MPL2 (T).
	(5) Effects on airport lighting (including variable intensity and fog effects).			✓		
	(6) Surface contaminants (including wind blowing effect).			✓		Not required for IR and MPL2 (T).
	(7) Variable precipitation effects (rain, hail, snow).			✓		Not required for IR and MPL2 (T).
	(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.			✓		Not required for IR and MPL2 (T).
	The wake turbulence model should support the representative effects of wake turbulence on the aeroplane being simulated. 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 aeroplane being simulated. The use of scenarios is encouraged.
11.3.G	The following weather effects as observed on the visual system should be simulated and respective instructor controls provided.					A subjective test is required. See Appendix C.
	(1) Visibility.	✓				

	Feature Technical Requirement Environment — Atmosphere and Weather	**G**	**R1**	**R**	**S**	**Comments**
11.4	INSTRUCTOR CONTROLS					
11.4.S	N/A.					
11.4.R,G	The following features should be simulated with appropriate instructor controls provided:					A subjective test is required. See Appendix C.
	(1) surface wind speed, direction and gusts;	✓		✓		For devices without motion, effects should be simulated on the instruments.
	(2) intermediate and high altitude wind speed and direction;			✓		
	(3) thunderstorms and microbursts; and	✓		✓		(3) Not required for IR and MPL2 (T).
	(4) turbulence.	✓		✓		

12. REQUIREMENT — ENVIRONMENT — AERODROMES AND TERRAIN

12.	Feature General Requirement Environment — Aerodromes and Terrain	G	R1	R	S	Comments
12.S	**N/A.**					
12.R	**Specific airport models with topographical features to support the approved 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.**			✓		***Note.— The requirements should be read in conjunction with Appendix C, section 12 to fully understand the details to be provided.***
12.R(S)	**Specific airport models with topographical features to support the approved 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.** **For specific VFR cross-country training the capability to replicate ground visual references and topographical features sufficient to support VFR navigation according to appropriate charts — minimum standard 1:500 000 scale mapping.**			✓	✓	**PPL application only.**
12.G	**Generic airport models with topographical features to support the approved use.** **Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways.**	✓				***Note.— The requirements should be read in conjunction with Appendix C, section 12 to fully understand the details to be provided.***
12.G(S)	**Generic airport models with topographical features to support the approved use.** **Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways.** **For specific VFR cross-country training the capability to replicate ground visual references and topographical features sufficient to support VFR navigation according to appropriate charts — minimum standard 1:500 000 scale mapping.**	✓			✓	**CPL application only.**

	Feature Technical Requirement Environment — Aerodromes and Terrain	G	R1	R	S	Comments
12.1	VISUAL CUES					
12.1.1. R(S), G(S)	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 (3) highly detailed and accurate surface depiction of the terrain surface within an area sufficient to achieve cross-country flying under VFR conditions.	✓		✓	✓	PPL and CPL application only.
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 (3) highly detailed and accurate surface depiction of the terrain surface within an approximate area from 400 m (1/4 sm) before the runway approach end to 400 m (1/4 sm) beyond the runway departure end with a total width of approximately 400 m (1/4 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.			✓		*Note.— For PPL (T), "(3) glow associated with approach lights in low visibility before physical lights are seen" is not required.*

	Feature Technical Requirement Environment — Aerodromes and Terrain	**G**	**R1**	**R**	**S**	**Comments**
12.3	ENVIRONMENT ATTITUDE					
12.3.1. S,R,G	The FSTD 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.a. R	The system should include at least three designated real-world airports available in daylight, twilight (dusk or dawn) and night illumination states.			✓		The designated real-world airports should be part of the approved training programme. Applicable to R with exception of PPL (T).
12.4.1.b. R	The system should include at least one designated real-world airport available in daylight, twilight (dusk or dawn) and night illumination states.			✓		The designated real-world airport(s) should be part of the approved training programme. Applicable to PPL (T) only.
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. S,R,G	Daylight capability.	✓		✓	✓	SOC required for system capability. System objective tests are required. See Appendix B, test 4.a (visual scene quality). Scene content tests are also required. See Appendix C.
12.4.2.2. S,R,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.	✓				
12.4.2.5. R	The system should have sufficient capacity to display 16 simultaneously moving objects.			✓		
12.4.3.1. S,R	Twilight (dusk) capability.			✓	✓	

	Feature Technical Requirement Environment — Aerodromes and Terrain	G	R1	R	S	Comments
12.4.3.2. S,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.			✓		
12.4.3.3. 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).			✓		
12.4.3.4 S,R	The system should include a definable horizon.			✓	✓	If provided, directional horizon lighting should have correct orientation and be consistent with surface shading effects.
12.4.3.6. R	The system should have sufficient capacity to display 16 simultaneously moving objects.			✓		
12.4.4. S,R	Night capability.			✓	✓	
12.4.4.1. S,R	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					Applicable to devices supporting the following: TP: MPL4, TR, ATPL, RO, IO, CQ and RL; and T: MPL4, Re.

	Feature Technical Requirement Environment — Aerodromes and Terrain	G	R1	R	S	Comments
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.			✓		Selection of the airport scenes to be agreed with the CAA. Changes should be incorporated in the simulator database within six months of being implemented in the corresponding real-world airport. 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 recognizable 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 used to support CPL and MPL1 or IR training, both applications allowing the use of a reduced FOV visual system.
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					
12.8.1.S, G(S), R(S)	The system, when used for VFR training, should include a database area that can support a 300 nautical miles triangular flight incorporating three airports. Within the defined area the system should replicate ground visual references and topographical features sufficient to support VFR navigation according to appropriate charts.				✓	Applies only to support VFR operations when used for CPL and PPL training. Correlation should be with 1:500 000 scale VFR Navigation Charts at a minimum, or larger scales (e.g. 1:250 000) if applicable to the area.
12.9	LOW VISIBILITY TRAINING					Applicable to devices supporting the following: TP: MPL4, TR, ATPL, RO, IO, CQ, RL and MPL3; and T: Re, MPL3 and MPL4.
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.			✓		

13. REQUIREMENT — MISCELLANEOUS

13.	Feature General Requirement Miscellaneous	G	R1	R	S	Comments
13.S	**N/A.**					
13.R	**N/A.**					
13.G	**N/A.**					

	Feature Technical Requirement Miscellaneous	G	R1	R	S	Comments
13.1	INSTRUCTOR OPERATING STATION					
13.1.S	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.
13.1.R	The instructor station should provide an adequate view of the pilots' panels and forward windows.			✓		
13.1.G	N/A.					
13.2	INSTRUCTOR CONTROLS					
13.2. S,R,G	Instructor controls should be provided for all required system variables, freezes and 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.	✓		✓	✓	
13.2.1.S (ctd next page)	The instructor station should provide adequate feedback and support of the aeroplane and controls state during upset prevention and recovery training (UPRT) exercises. This should include: (1) FSTD validation envelope. This should be in the form of an alpha/beta envelope (or equivalent method) depicting the “confidence level” of the aerodynamic model depending on the degree of flight validation or source of predictive methods. The envelopes should provide the instructor real-time feedback on the simulation during a manoeuvre. There should be a minimum of a flaps up and flaps down envelope available. This presentation should include a time history and should be available for debrief purposes.				✓	Only required for UPRT training. For examples of the instructor feedback mechanism, see Part II, Attachment P. For the operational limits it is highly recommended that normal load factor (n) and airspeed (V) limits be displayed on a V-n display bounded by operational load limits and operating speeds. This display should be constructed in accordance with the OEM data and should incorporate the OEM's operating recommendations.

	Feature Technical Requirement Miscellaneous	G	R1	R	S	Comments
13.2.1.S (ctd)	(2) Flight control positions. This should enable the instructor to assess the pilot's flight control inputs. It should include rudder pedal displacement and control forces as well as the primary control channels (including fly-by-wire as appropriate). The tool should display feedback in real-time, and record parameters for displaying a time history and for debrief purposes; and (3) Aeroplane operational limits. This should display the aircraft operating limits during the manoeuvre applicable for the configuration of the aeroplane. The information should be displayed in real-time and recorded for debrief. The time history should be displayed graphically in a format that makes information available and useful to the instructor.					
13.2.2.S	Selectable aeroplane upsets should be provided and supported by guidance to the instructor concerning the method utilized to drive the FSTD into an upset condition including any malfunction or degradation in the FSTD's functionality required to initiate the upset.				✓	Only required for UPRT training The following minimum set of upset recovery manoeuvres should be available to the instructor: — a nose-high, wings level aircraft upset; — a nose-low, wings level aircraft upset; and — a high bank angle aircraft upset. Other upset recovery scenarios as developed by the FSTD operator should be evaluated in the same manner. The intentional degradation of FSTD functionality to drive an aeroplane upset is generally not acceptable unless used purely as a tool for repositioning with the pilot out of the loop. *Note.— Care should be taken with flight envelope protected aeroplanes, as artificially positioning the aeroplane to a specified attitude may not be representative because the flight control law may not be correctly initialized.*
13.3	SELF—DIAGNOSTIC TESTING					
13.3.S	Self-diagnostic testing of the 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.				✓	SOC required.

	Feature Technical Requirement Miscellaneous	G	R1	R	S	Comments
13.4	COMPUTER CAPACITY					
13.4. S,R,G	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.	✓		✓	✓	SOC required.
13.5	AUTOMATIC TESTING FACILITIES					
13.5.S	Automatic QTG/validation testing of FSTD hardware and software to determine compliance with the validation requirements 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 standard.
13.5.R,G	Validation testing of FSTD hardware and software 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 Master QTG test standard. Automatic QTG validation/testing is encouraged.
13.6	UPDATES TO FSTD HARDWARE AND SOFTWARE					
13.6.S,R	Timely permanent update of FSTD hardware and software should be conducted subsequent to aeroplane modification where it affects training, sufficient for the qualification level sought.			✓	✓	
13.6.G	Timely permanent update of FSTD hardware and software should be conducted subsequent to FSTD manufacturer recommendation where it affects training and/or safety.	✓				
13.7	DAILY PRE-FLIGHT DOCUMENTATION					
13.7. S,R,G	Daily pre-flight documentation either in the daily log or in a location easily accessible for review is required.	✓		✓	✓	

	Feature Technical Requirement Miscellaneous	G	R1	R	S	Comments
13.8	SYSTEM INTEGRATION					
13.8	System Integration. Relative response of the visual system, flight deck instruments and initial motion system coupled closely to provide integrated sensory cues. 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. 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. 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 CAA.					Test required. See Appendix B, test 6.a (transport delay). Latency test may be used as an alternate means of compliance in place of the transport delay test. Part II, Attachment G provides guidance for transport delay and for latency test methodology.
13.8.S	Transport delay: A transport delay test may be used to demonstrate that the FSTD system response does not exceed 100 ms for the motion and instrument systems and 120 ms for the visual system. Where EFVS systems are installed, they should respond within ±30 ms from the visual system response, and not before motion system response.				✓	Results required for instruments, motion and visual systems. Additional transport delay test results are required where HUD 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.
13.8.R,G	Transport delay: A transport delay test may be used to demonstrate that the FSTD system response does not exceed 200 ms.	✓		✓		Results required for applicable systems only.

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Appendix B

VALIDATION TESTS FOR FEATURE FIDELITY LEVELS

For detailed information for these tests see Part II, Appendix B, sections 1 to 3.

Note.— Where a validation test has a dependency upon more than one FSTD fidelity feature and it is important for these fidelity levels to be the same, the validation test section is annotated to this effect to highlight the importance of the features' inter-dependency for cohesive testing.

TABLE OF FSTD VALIDATION TESTS

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
1.	PERFORMANCE							
1.a	**Taxi**							For validation tests in this section the following device features should be to the same fidelity level: — flight model; — ground handling; — flight controls and forces; and — aeroplane systems.
1.a	(1) Minimum radius turn.	±0.9 m (3 ft) or ±20% of aeroplane turn radius.	Ground.				✓	Plot both main and nose gear 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 of turn rate.	Ground.				✓	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**							For validation tests in this section the following device features should be to the same fidelity level: — flight model; — ground handling; — flight controls and forces; and — aeroplane systems. *Note.— All aeroplane manufacturer commonly-used certificated 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 crosswind take-off (1.b.6).*
1.b	(1) Ground acceleration time and distance.	For level S: ±1.5 s or ±5% of time. ±61 m (200 ft) or ±5% of distance.	Take-off.				✓	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.
		For level R or R1: ±1.5 s or ±5% of time.			✓	✓		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
1.b	(2) Minimum control speed, ground (V_{mcg}) using 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: ±2.2 daN (5 lbf) or ±10% of rudder pedal force.	Take-off.				✓	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 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 V_{mcg} test is not available, an acceptable alternative is a flight test snap engine deceleration to idle at a speed between V_1 and V_1-10 kt, followed by control of heading using aerodynamic control only and recovery should be achieved with the main gear on the ground.
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.				✓	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 seconds 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: ±2.2 daN (5 lbf) or ±10% of column force.	Take-off.				✓	Data required for near maximum certificated take-off mass at mid centre of gravity location and light take-off mass at an aft centre of gravity location. If the aeroplane has more than one certificated take-off configuration, a different configuration should be used for each mass. 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.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
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: ±2.2 daN (5 lbf) or ±10% of column force. ±1.3 daN (3 lbf) or ±10% of wheel force. ±2.2 daN (5 lbf) or ±10% of rudder pedal force.	Take-off.				✓	Record take-off profile to at least 61 m (200 ft) AGL. Engine failure speed should be within ±3 kt of aeroplane data. Test at near MCTM.
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 angle. Correct trends at ground speeds below 40 kt for rudder/pedal and heading angle. For aeroplanes with reversible flight control systems: ±2.2 daN (5 lbf) or ±10% of column force. ±1.3 daN (3 lbf) or ±10% of wheel force. ±2.2 daN (5 lbf) or ±10% of rudder pedal force.	Take-off				✓	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 10 m (33 ft) above the runway. Wind components should be provided as headwind and crosswind values with respect to the runway.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
1.b	(7) Rejected take-off.	For level S: ±5% of time or ±1.5 s. ±7.5% of distance or ±76 m (250 ft).	Take-off.				✓	Record at mass near MCTM. 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 full reverse, if applicable. Time and distance should be recorded from brake release to a full stop. For level R or R1 devices, record time for at least 80% of the time segment from initiation of the rejected take-off to full stop.
		For level R or R1: ±5% of time or ±1.5 s.			✓	✓		
1.b	(8) Dynamic engine failure after take-off.	±2°/s or ±20% of body angular rates.	Take-off.				✓	Engine failure speed should be within ±3 kt of aeroplane data. Engine failure may be a snap deceleration to idle. Record hands-off from 5 s before engine failure to +5 s or 30° roll angle, 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**							For validation tests in this section the following device features should be to the same fidelity level: — flight model; — flight controls and forces; and — aeroplane systems.
1.c	(1) Normal climb all engines operating.	±3 kt airspeed. ±0.5 m/s (100 ft/min) or ±5% of rate of climb.	Clean.	C T & M	✓	✓	✓	Flight test data are preferred; however, aeroplane performance manual data are an acceptable alternative. Record at nominal climb speed and mid initial climb altitude. FSTD performance is to be recorded over an interval of at least 300 m (1 000 ft). For level G, R and R1 devices, this test may be a snapshot test.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
1.c	(2) One-engine-inoperative 2nd segment climb.	±3 kt airspeed. ±0.5 m/s (100 ft/min) or ±5% of rate of climb, but not less than aeroplane performance data requirements.	2nd segment climb.	C T & M	✓	✓	✓	Flight test data are preferred; however, aeroplane performance manual data are an acceptable alternative. Record at nominal climb speed. FSTD performance is to be recorded over an interval of at least 300 m (1 000 ft). Test at WAT (weight, altitude or temperature) limiting condition. For level G, R and R1 devices, this test may be a snapshot test.
1.c	(3) One-engine-inoperative en-route climb.	±10% of time. ±10% of distance. ±10% of fuel used.	Clean.				✓	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. ±0.5 m/s (100 ft/min) or ±5% rate of climb, but not less than aeroplane performance data requirements.	Approach.				✓	Flight test data or aeroplane performance manual data may be used. FSTD performance to be recorded over an interval of at least 300 m (1 000 ft). Test near maximum certificated landing mass 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**							For validation tests in this section the following device features should be to the same fidelity level: — flight model; — flight controls and forces; and — aeroplane systems.
1.d	(1) Level flight acceleration.	±5% of time.	Cruise.		✓	✓	✓	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 change.
1.d	(2) Level flight deceleration.	±5% of time.	Cruise.		✓	✓	✓	Time required to decrease airspeed 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 change.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
1.d	(3) Cruise performance.	±.05 EPR or ±3% N_1 or ±5% of torque. ±5% of fuel flow.	Cruise.		✓	✓	✓	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. ±1.0 m/s (200 ft/min) or ±5% of rate of descent.	Clean.				✓	Idle power stabilized 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. ±1.5 m/s (300 ft/min) or ±5% of rate of descent.	As per aeroplane performance data.				✓	Stabilized descent to be conducted with speed brakes extended if applicable, at mid-altitude and near V_{mo} or according to emergency descent procedure. FSTD performance to be recorded over an interval of at least 900 m (3 000 ft).
1.e	**Stopping**							For validation tests in this section the following device features should be to the same fidelity level: — flight model; — ground handling; — flight controls and forces; and — aeroplane systems.
1.e	(1) Deceleration time and distance, manual wheel brakes, dry runway, no reverse thrust.	±1.5 s or ±5% of time. For distances up to 1 220 m (4 000 ft), the smaller of ±61 m (200 ft) or ±10% of distance. For distances greater than 1 220 m (4 000 ft), ±5% of distance.	Landing.				✓	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 certificated 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.	±1.5 s or ±5% of time; and the smaller of ±61 m (200 ft) or ±10% of distance.	Landing.				✓	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 certificated landing mass. Engineering data may be used for the medium mass condition.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
1.e	(3) Stopping distance, wheel brakes, wet runway.	±61 m (200 ft) or ±10% of distance.	Landing.				✓	Either flight test or manufacturer's performance manual data should be used, where available. Engineering data, based on dry runway flight test stopping distance and the effects of contaminated runway braking coefficients, are an acceptable alternative.
1.e	(4) Stopping distance, wheel brakes, icy runway.	±61 m (200 ft) or ±10% of distance.	Landing.				✓	Either flight test or manufacturer's performance manual data should be used, where available. Engineering data, based on dry runway flight test stopping distance and the effects of contaminated runway braking coefficients, are an acceptable alternative.
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.				✓	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. See Part II, Appendix B, 3.1 and Figure B-1.
		For level R or R1: ±10% T_i or ±1 s; and ±10% T_t or ±1 s.			✓	✓		
		For level G: ±10% T_i or ±1 s; and ±10% T_t or ±1 s.		CT&M				
1.f	(2) Deceleration.	±10% T_i or ±0.25 s; and ±10% T_t or ±0.25 s.	Ground.				✓	T_i = total time from initial throttle movement until a critical engine parameter reaches 10% of its total response below maximum take-off power. T_t = 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. See Part II, Appendix B, 3.1 and Figure B-2.
		For level R or R1: ±10% T_i or ±1 s; and ±10% T_t or ±1 s.			✓	✓		
		For level G: ±10% T_i or ±1 s; and ±10% T_t or ±1 s.		CT&M				

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.	HANDLING QUALITIES							
2.a	**Static control checks**							
	Note 1.— Testing of position versus force is not applicable if forces are generated solely by use of aeroplane hardware in the FSTD. *Note 2.— 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 and/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 3.— 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.*							
2.a	(1) Pitch controller position versus force and surface position calibration.	±0.9 daN (2 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force. ±2° elevator angle.	Ground.			✓	✓	Uninterrupted control sweep to stops. Test results should be validated with in-flight data from tests such as longitudinal static stability, stalls, etc.
	Pitch controller position versus force.	±0.9 daN (2 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force.	Approach.	CT&M	CT&M			Control forces and travel should broadly correspond to that of the class of aeroplane being simulated.
2.a	(2) Roll controller position versus force and surface position calibration.	±0.9 daN (2 lbf) breakout. ±1.3 daN (3 lbf) or ±10% of force. ±2° aileron angle. ±3° spoiler angle.	Ground.			✓	✓	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 lbf) breakout. ±1.3 daN (3 lbf) or ±10% of force.	Approach.	CT&M	CT&M			Control forces and travel should broadly correspond to that of the class of aeroplane being simulated.
2.a	(3) Rudder pedal position versus force and surface position calibration.	±2.2 daN (5 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force. ±2° rudder angle.	Ground.			✓	✓	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 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force.	Approach.	CT&M	CT&M			Control forces and travel should broadly correspond to that of the class of aeroplane being simulated.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.a	(4) Nosewheel steering controller force and position calibration.	±0.9 daN (2 lbf) breakout. ±1.3 daN (3 lbf) or ±10% of force. ±2° NWA.	Ground.		C T & M	✓	✓	Uninterrupted control sweep to stops.
2.a	(5) Rudder pedal steering calibration.	±2° NWA.	Ground.		✓	✓	✓	Uninterrupted control sweep to stops.
2.a	(6) Pitch trim versus surface position calibration.	±0.5° trim angle.	Ground.				✓	The purpose of the test is to compare FSTD surface position indicator against the FSTD flight controls model computed value
		±1.0° trim angle.		C T & M	✓	✓		
2.a	(7) Pitch trim rate.	±10% of trim rate (°/s) or ±0.1°/s trim rate.	Ground and approach.		✓	✓	✓	Trim rate to be checked at pilot primary induced trim rate (ground) and autopilot or pilot primary trim rate in-flight at go-around flight conditions. 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: ±3% N_1 or ±.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.	C T & M	✓	✓	✓	Simultaneous recording for all engines. The tolerances apply against 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 are acceptable, provided 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.
2.a	(9) Brake pedal position versus force and brake system pressure calibration.	±2.2 daN (5 lbf) or ±10% of force. ±1.0 MPa (150 psi) or ±10% of brake system pressure.	Ground.				✓	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.
		For level R or R1: ±2.2 daN (5 lbf) or ±10% of force.			C T & M	✓		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.a	(10) Stick pusher system force calibration.	±10% or ±2.2 daN (5 lbf) stick/column force	Ground or flight.				✓	Aeroplane manufacturer design data should be utilized as validation data as determined acceptable by the CAA. Test requirement should be met through column force validation testing in conjunction with test 2.c.8a (stall characteristics). Test is intended to validate the stick/column transient forces as a result of a stick pusher system activation to prevent an aerodynamic stall. This test should be conducted in an on-ground condition through stimulation of the stall protection system in a manner that generates a stick pusher response that is exemplar of an in-flight condition. *Note.— See Part II, Attachment P, 2.1 for a definition of "exemplar".*
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. See Part II, Appendix B, 3.2.							
2.b	(1) Pitch control. (ctd next page)	For **underdamped systems** (as per Part II, Appendix B, Figure B-3): $T(P_0)$ ±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. $T(A_n)$ ±10% of A_{max}, where A_{max} is the largest amplitude or ±0.5% of the total control travel (stop to stop). $T(A_d)$ ±5% of A_d = residual band or ±0.5% of the maximum control travel = residual band.	Take-off, cruise and landing.				✓	Data should be for normal control displacements in both directions (approximately 25% to 50% of 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. See Part II, Appendix B, 3.2.2, 3.2.3, 3.2.4 and 3.2.5. For overdamped and critically damped systems, see Part II, Appendix B, Figure B-4 for an illustration of the reference measurement.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.b	(1) Pitch control. (ctd)	±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: $T(P_0)$ ±10% of P_0 or ±0.05 s.						
2.b	(2) Roll control.	Same as 2.b.1.	Take-off, cruise and landing.				✓	Data should be for normal control displacement (approximately 25% to 50% of full throw or approximately 25% to 50% of maximum allowable roll controller deflection for flight conditions limited by the manoeuvring load envelope). See Part II, Appendix B, 3.2.2, 3.2.3, 3.2.4 and 3.2.5.
2.b	(3) Yaw control.	Same as 2.b.1.	Take-off, cruise and landing.				✓	Data should be for normal control displacement (approximately 25% to 50% of full throw). See Part II, Appendix B, 3.2.2, 3.2.3, 3.2.4 and 3.2.5.
2.b	(4) Small control inputs — pitch. (ctd next page)	±0.15°/s body pitch rate or ±20% of peak body pitch rate applied throughout the time history.	Approach or landing.				✓	Control inputs should be typical of minor corrections made while established on an ILS approach (approximately 0.5 to 2°/s pitch rate). Test in both directions. Show time history data from 5 s before until at least 5 s after initiation of control input.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.b	(4) Small control inputs — pitch. (ctd)							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	(5) Small control inputs — roll.	±0.15°/s body roll rate or ±20% of peak body roll rate applied throughout the time history.	Approach or landing.				✓	Control inputs should be typical of minor corrections made while established on an ILS approach (approximately 0.5 to 2°/s roll rate). Test in one direction. For aeroplanes that exhibit non-symmetrical behaviour, test in both directions. Show time history data from 5 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.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.				✓	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**							For validation tests in this section the following device features should be to the same fidelity level: — flight model; — flight controls and forces; and — aeroplane systems. *Note.— Power setting may be that required for level flight unless otherwise specified.*

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.c	(1) Power change dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Approach.	C T & M	✓	✓	✓	Power change from thrust for approach or level flight to maximum continuous or go-around power. Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the power change to the completion of the power change +15 s. **CCA:** Test in normal and non-normal control mode for level S devices. For level G, R and R1 devices, test in normal mode only.
	OR for level G: (1) Power change force.	±2.2 daN (5 lbf) or ±20% of pitch controller force.		C T & M				Force tests (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% of pitch angle.	Take-off through initial flap retraction, and approach to landing.	C T & M	✓	✓	✓	Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the configuration change to the completion of the configuration change +15 s. **CCA:** Test in normal and non-normal control mode for level S devices. For level G, R and R1 devices, test in normal mode only.
	OR for level G: (2) Flap change force.	±2.2 daN (5 lbf) or ±20% of pitch controller force.		C T & M				Force tests (level G devices) should provide the force required to maintain constant airspeed or altitude to complete the configuration change.
2.c	(3) Spoiler/ speedbrake change dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Cruise.	C T & M	✓	✓	✓	Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the configuration change to the completion of the configuration change +15 s. Results required for both extension and retraction. **CCA:** Test in normal and non-normal control mode for level S devices. For level G, R and R1 devices, test in normal mode only.
2.c	(4) Gear change dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Take-off (retraction) and approach (extension).	C T & M	✓	✓	✓	Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the configuration change to the completion of the configuration change +15 s. **CCA:** Test in normal and non-normal control mode for level S devices. For level G, R and R1 devices, test in normal mode only.
	OR for level G: (4) Gear change force.	±2.2 daN (5 lbf) or ±20% of pitch controller force.		C T & M				Force tests (level G devices) should provide the force required to maintain constant airspeed or altitude to complete the configuration change.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.c	(5) Longitudinal trim.	For level S: ±1° elevator angle. ±0.5° stabilizer angle. ±1° pitch angle. ±5% of net thrust or equivalent.	Cruise, approach and landing.				✓	Steady-state wings level trim with thrust for level flight. This test may be a series of snapshot tests. **CCA:** Test in normal or non-normal control mode, as applicable.
		For level R or R1: ±2° elevator angle. ±1° stabilizer angle. ±2° pitch angle. ±5% of net thrust or equivalent.			✓	✓		Level R and R1 devices may use pitch controller position instead of elevator angle and trim control position instead of stabilizer angle.
		For level G: ±2° elevator angle. ±1° stabilizer angle. ±2° pitch angle. ±5% of net thrust or equivalent.		CT&M				
2.c	(6) Longitudinal manoeuvring stability (stick force/g).	±2.2 daN (5 lbf) or ±10% of pitch controller force.	Cruise, approach and landing.	CT&M	CT&M	✓	✓	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 mode for level S devices. For level G, R and R1 devices, test in normal mode only.
		Alternative method: ±1° or ±10% of the change of elevator angle.		CT&M	CT&M	✓	✓	Alternative method applies to aeroplanes which do not exhibit stick-force-per-g characteristics. For the alternative method, level R and R1 devices may use pitch controller position instead of elevator angle.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.c	(7) Longitudinal static stability.	±2.2 daN (5 lbf) or ±10% of pitch controller force.	Approach.	C T & M	C T & M	✓	✓	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 is not applicable if forces are generated solely by the use of aeroplane hardware in the FSTD. **CCA:** Test in normal or non-normal control mode, as applicable.
		Alternative method: ±1° or ±10% of the change of elevator angle.		C T & M	C T & M	✓	✓	Alternative method applies to aeroplanes which do not exhibit speed stability characteristics. For the alternative method, level R and R1 devices may use pitch controller position instead of elevator angle.
2.c	(8a) Stall characteristics. (ctd next page)	±3 kt airspeed for stall warning and stall speeds. ±2.0° angle of attack for buffet threshold of perception and initial buffet based on 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° roll angle. Stall warning up to stall: ±2.0° pitch angle; ±2.0° angle of attack; and correct trend and magnitude for lateral/directional body rates. For FSTDs with reversible flight control systems: ±10% or ±2.2 daN (5 lbf) stick/column force (prior to g-break only).	2nd climb, cruise (high altitude) and approach or landing.				✓	See Part II, Attachment P, 1.1 for applicability. The following stall entry methods should be demonstrated in at least one of the three required flight conditions: — stall entry at wings level (1 g); — stall entry in turning flight of at least 25° bank angle (accelerated stall); and — stall entry in a power-on condition (required only for turboprop aeroplanes). The required cruise condition should be conducted in a flaps up (clean) configuration. 2nd segment climb and approach/landing conditions should be conducted at different flap settings. Record the stall warning signal and initial buffet, if applicable. Time history data should be recorded for full stall and recovery through normal flight. The stall warning signal should occur in the proper relation to buffet/stall. FSTDs of aeroplanes exhibiting a sudden pitch attitude change or “g break” should demonstrate this characteristic. FSTDs of aeroplanes exhibiting a random roll off and/or loss of roll control authority should demonstrate this characteristic. SOC required (see Part II, Attachments C and P), as applicable, for the stall break and recovery, aerodynamic modelling, stick pusher modelling, etc.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.c	(8a) Stall characteristics. (ctd)	For FSTDs of aeroplanes equipped with stick pusher systems: ±10% or ±2.2 daN (5 lbf) stick/column force applied throughout the time history to just prior to the stick pusher activation.						

Additional Notes for 2.c.8a.

"Approach to stall" tolerances apply up to the activation of the stall warning system or aerodynamic stall buffet, whichever occurs first. "Stall warning up to stall" tolerances apply from the activation of the stall warning system or aerodynamic stall buffet, whichever occurs first, to just prior to the stall break. "Stall break and recovery" applies from just prior to the stall break (pitch break, g-break, stick pusher activation or other indication of a full/aerodynamic stall) through recovery to normal flight.

Due to the inherently unstable and non-repeatable behaviour of the stall manoeuvre, parameters from the stall break and recovery will only be subject to correct trend and magnitude tolerances for the purpose of continuing qualification evaluations.

Buffet threshold of perception to be based on normal acceleration at the pilot seat of 0.03 g peak to peak above the background noise. . 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 manufacturers have used 0.1 g peak to peak). Demonstrate correct trend in growth of buffet amplitude from buffet threshold of perception to critical angle of attack for Ny and Nz. The FSTD manufacturer may limit maximum buffet based on motion platform capability or limitations.

Where approved engineering simulation validation is used, the reduced engineering tolerances (as defined in Part II, Attachment C) do not apply.

Tests may be conducted at a centre of gravity typically required for aeroplane certification stall testing.
Tolerances are applied to Nz, though correct trends are required for Nx and Ny, if relevant.

CCA: Test in normal and non-normal control states. For CCA aeroplanes with stall envelope protection systems, tests are only required in non-normal control state if acceptable angle of attack envelope protection tests are provided (see test 2.h (flight and manoeuvre envelope protection functions)).

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.c	(8b) Approach to stall characteristics.	±3 kt airspeed for stall warning speeds. ±2° roll angle for speeds greater than stick shaker or initial buffet. For aeroplanes with reversible flight control systems: ±10% or ±2.2 daN (5 lbf) of column force (prior to g-break only).	2nd segment climb and approach or landing.				✓	Wings-level (1 g) stall entry with thrust at or near idle power. Time history data should be shown to first indication of stall and recovery. Stall warning signal should be recorded. **CCA:** Test in normal and non-normal control mode for level S devices, as applicable. For level R, R1 and G devices test in normal mode only, as applicable.
		For level R, R1 and G (the manoeuvre need not include full stall): ±3 kt airspeed for stall warning.		C T & M	✓	✓		
	Additional Notes for 2.c.8b. Source data and modelling methods: The SOC must identify the sources of data used to develop the aerodynamic model. Of particular interest is a mapping of test points in the form of 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. In cases where limited data is available to model and/or validate the stall characteristics (e.g. safety issues involving the collection flight test data), the data provider is expected to make a reasonable attempt to develop a stall model through analytical methods and utilization of the best available data.							
2.c	(9) Phugoid dynamics.	±10% of period. ±10% of time to one half or double amplitude or ±0.02 of damping ratio.	Cruise.				✓	Test should include three full cycles or that necessary to determine time to one half or double amplitude, whichever is less. **CCA:** Test in non-normal control mode.
		For level R, R1 and G: ±10% of period, with representative damping.		C T & M	✓	✓		
2.c	(10) Short period dynamics.	±1.5° pitch angle or ±2°/s pitch rate. ±0.1 g normal acceleration.	Cruise.				✓	**CCA:** Test in normal and non-normal control mode.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.d	**Lateral directional**							For validation tests in this section the following device features should be to the same fidelity level: — flight model; — flight controls and forces; and — aeroplane systems. *Note.— Power setting may be that required for level flight unless otherwise specified.*
2.d	(1) Minimum control speed, air (V_{mca}) or landing (V_{mcl}), per applicable airworthiness requirement 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	CT&M	✓	Minimum speed may be defined by a performance or control limit which prevents demonstration of V_{mca} 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. For level G, R and R1 devices, it is important that there exists a realistic speed relationship between V_{mca} (or V_{mcl}) and V_s for all configurations and in particular the most critical full-power engine-out configuration. **CCA:** Test in normal or non-normal control state, as applicable.
2.d	(2) Roll response (rate).	±2°/s or ±10% of roll rate.	Cruise and approach or landing.	CT&M	✓	✓	✓	Test with normal roll control displacement (approximately one-third of maximum roll controller travel). This test may be combined with test 2.d.3 (step input of flight deck roll controller).
		For aeroplanes with reversible flight control systems: ±1.3 daN (3 lbf) or ±10% of wheel force.		CT&M	CT&M	✓	✓	
2.d	(3) Step input of flight deck roll controller.	±2° or ±10% of roll angle.	Approach or landing.		✓	✓	✓	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 test 2.d.2 (roll response (rate)). **CCA:** Test in normal and non-normal control mode for level S devices. For level R and R1 devices test in normal mode only.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.d	(4) Spiral stability.	Correct trend and ±2° or ±10% of roll angle in 20 s. If alternate test is used: correct trend and ±2° aileron angle.	Cruise and approach or landing.				✓	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 mode.
		For level G, R and R1: Correct trend and ±3° or ±10% of roll angle in 20 s.		CT&M	✓	✓		
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.		✓	✓	✓	Test should be performed in a manner similar to that for which a pilot is trained to trim an engine failure condition. The 2nd segment climb test should be at take-off thrust. Approach or landing test should be at thrust for level flight. This test may consist of snapshot tests. For level R and R1 devices, sideslip angle is matched only for repeatability and only on continuing recurrent evaluations.
2.d	(6) Rudder response.	±2°/s or ±10% of yaw rate.	Approach or landing.		✓	✓	✓	Test with stability augmentation on and off. Test with a step input at approximately 25% of full rudder pedal throw. **CCA:** Test in normal and non-normal control mode for level S devices. For level G, R and R1 devices, test in normal mode only.
		OR for level G: ±2°/s or ±10% of yaw rate or ±10% of heading change.		CT&M				
2.d	(7) Dutch roll.	±0.5 s or ±10% of period. ±10% of time to one half or double amplitude or ±.02 of damping ratio. ±1 s or ±20% of time difference between peaks of roll angle and sideslip angle.	Cruise and approach or landing.				✓	Test for at least six cycles with stability augmentation off. **CCA:** Test in non-normal control mode.
		For level R or R1: ±0.5 s or ±10% of period, with representative damping.			✓	✓		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.d	(8) Steady state sideslip.	For a given rudder position: ±2° roll angle; ±1° sideslip angle; ±2° or ±10% of aileron angle. ±5° or ±10% of spoiler or equivalent roll controller position or force.	Approach or landing.	C T & M	✓	✓	✓	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 maximum allowable rudder. For R and R1 devices, 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 lbf) or ±10% of wheel force. ±2.2 daN (5 lbf) or ±10% of rudder pedal force.		C T & M	C T & M	✓	✓	
2.e	**Landings**							For validation tests in this section the following device features should be to the same fidelity level: — flight model; — ground handling; — flight controls and forces; and — aeroplane systems.
2.e	(1) Normal 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: ±2.2 daN (5 lbf) or ±10% of column force.	Landing.				✓	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 certificated landing mass, the other at light or medium mass. CCA: Test in normal and non-normal control mode, as applicable.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
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: ±2.2 daN (5 lbf) or ±10% of column force.	Minimum certificated landing flap configuration.				✓	Test from a minimum of 61 m (200 ft) AGL to nosewheel touchdown. Test at near maximum certificated landing mass.
2.e	(3) Crosswind landing.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±3 m (10 ft) or ±10% of height. ±2° roll angle. ±2° sideslip angle. ±3° heading angle. For aeroplanes with reversible flight control systems: ±2.2 daN (5 lbf) or ±10% of column force. ±1.3 daN (3 lbf) or ±10% of wheel force. ±2.2 daN (5 lbf) or ±10% of rudder pedal force.	Landing.				✓	Test from a minimum of 61 m (200 ft) AGL to a 50% decrease in main landing gear touchdown speed. It 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% of height. ±2° roll angle. ±2° sideslip angle. ±3° heading angle.	Landing.				✓	Test from a minimum of 61 m (200 ft) AGL to a 50% decrease in main landing gear touchdown speed.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.e	(5) Autopilot landing (if applicable).	±1.5 m (5 ft) flare height. ±0.5 s or ±10% of T_f. ±0.7 m/s (140 ft/min) rate of descent at touchdown. ±3 m (10 ft) lateral deviation during roll-out.	Landing.				✓	If the autopilot provides roll-out guidance, record lateral deviation from touchdown to a 50% decrease in main landing gear touchdown speed. Time of autopilot flare mode engagement to main gear touchdown should be noted. 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.				✓	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° roll angle. ±2° sideslip angle.	As per aeroplane performance data.				✓	Engine inoperative go-around required near maximum certificated landing mass with critical engine 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.				✓	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 reverse thrust (asymmetric).	±5 kt airspeed. ±3° heading angle.	Landing.				✓	With full reverse thrust on the operating engine(s), maintain heading with rudder pedal input until maximum rudder pedal input or thrust reverser minimum operation speed is reached.
2.f	**Ground effect**							For validation tests in this section the following device features should be to the same fidelity level: — flight model; — flight controls and forces; and — aeroplane systems.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
2.f	(1) A test to demonstrate ground effect.	±1° elevator angle. ±0.5° stabilizer angle. ±5% of net thrust or equivalent. ±1° AOA. ±1.5 m (5 ft) or ±10% of height. ±3 kt airspeed. ±1° pitch angle.	Landing.				✓	See Part II, Appendix B, 3.3.2. A rationale should be provided with justification of results. **CCA:** Test in normal or non-normal control mode, as applicable.
2.g	**Wind shear**							For validation tests in this section the following device features should be to the same fidelity level: — flight model; — ground handling; — flight controls and forces; and — aeroplane systems.
2.g	(1) A test to demonstrate wind shear models.	None.	Take-off and landing.				✓	See Appendix A, 11.2 — Wind Shear.
2.h	**Flight and manoeuvre envelope protection functions**							For validation tests in this section the following device features should be to the same fidelity level: — flight model; — flight controls and forces; and — aeroplane systems. *Note.— The requirements of 2.h are only applicable to computer-controlled aeroplanes. Time history results of response to control inputs during entry into each envelope protection function (i.e. with normal and degraded control states if function is different) are required. Set thrust as required to reach the envelope protection function.*
2.h	(1) Overspeed.	±5 kt airspeed.	Cruise.				✓	
2.h	(2) Minimum speed.	±3 kt airspeed.	Take-off, cruise and approach or landing.				✓	
2.h	(3) Load factor.	±0.1 g normal acceleration.	Take-off and cruise.				✓	
2.h	(4) Pitch angle.	±1.5° pitch angle.	Cruise and approach.				✓	

<table>
<tr><th></th><th>Test</th><th>Tolerance</th><th>Flight Condition</th><th>G</th><th>R1</th><th>R</th><th>S</th><th>Comments</th></tr>
<tr><td>2.h</td><td>(5) Roll angle.</td><td>±2° or ±10% of roll angle.</td><td>Approach.</td><td></td><td></td><td></td><td>✓</td><td></td></tr>
<tr><td>2.h</td><td>(6) Angle of attack.</td><td>±1.5° AOA.</td><td>2nd segment climb and approach or landing.</td><td></td><td></td><td></td><td>✓</td><td></td></tr>
<tr><td>2.i</td><td>Engine and airframe icing effects</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.i</td><td>(1) Engine and airframe icing effects demonstration (aerodynamic stall).</td><td></td><td>Take-off or approach or landing

(One flight condition — two tests (ice on and off)).</td><td></td><td></td><td></td><td>✓</td><td>Tests will be evaluated for representative effects on relevant aerodynamic parameters such as angle of attack, control inputs and thrust/power settings.

See additional notes below.</td></tr>
<tr><td></td><td colspan="8">Additional notes for 2.i.1.

Plotted parameters should include:

— altitude;
— airspeed;
— normal acceleration;
— engine power;
— angle of attack;
— pitch attitude;
— roll angle;
— flight control inputs; and
— stall warning and stall buffet threshold of perception.

Time history of a full stall and initiation of the recovery. Tests are intended to demonstrate representative aerodynamic effects caused by in-flight ice accretion. Flight test validation data are not required.

Two tests are required to demonstrate engine and airframe icing effects. One test will demonstrate the FSTD’s baseline performance without icing and the second test will demonstrate the aerodynamic effects of ice accretion relative to the baseline test.

The test should utilize the icing model(s) as described in the required SOC in Appendix A, 2.1.S.e. The test should include a rationale that describes the icing effects being demonstrated. Icing effects should include, but are not limited to, the following effects as applicable to the particular aeroplane:

— decrease in stall angle of attack;
— changes in pitching moment;
— decrease in control effectiveness;
— changes in control forces;
— increase in drag;
— change in stall buffet characteristics and threshold of perception; and
— engine effects (power reduction/variation, vibration, etc.).</td></tr>
</table>

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
3.	MOTION SYSTEM							
3.a	**Frequency response.**	As specified by the applicant for FSTD qualification.	Not applicable.		✓	✓		Appropriate test to demonstrate required frequency response. See Part II, Appendix B, 3.5.2.
	Leg balance.	Not applicable.						Not applicable.
3.b	**Turn-around check.**	As specified by the applicant for FSTD qualification.	Not applicable.		✓	✓		Appropriate test to demonstrate required smooth turn-around. See Part II, Appendix B, 3.5.2.
3.c	**Motion effects.**							See Appendix C.
3.d	**Motion system repeatability.**	±0.05 g actual platform linear accelerations.	None.		✓	✓		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 Part II, Appendix B, 3.5.4.
3.e	(1) Motion cueing fidelity — Frequency-domain criterion.	See Part II, Attachment F.	Ground and flight.			✓		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 aeroplane being simulated. This test is only required during the initial FSTD qualification or if changes are made to the motion drive algorithms. See Part II, Appendix B, 3.5.3.
3.e	(2) Motion cueing fidelity — Time-domain criterion.	TBD.	Ground and flight.			✓		Appropriate testing criterion and tolerances are currently being tested and evaluated through the mechanism described in Part II, Appendix D.
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 for the aeroplane type.							The recorded test results for characteristic buffets should allow the comparison of relative amplitude versus frequency. See Part II, Appendix B, 3.5.5. For level R1 devices, footprint test results are required.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
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 of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Ground.		✓	✓		The test should be conducted at maximum possible thrust with brakes set.
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 of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Flight.		✓	✓		The 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 of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Flight.		✓	✓		The test condition should be at a normal operational speed and not at the flap limiting speed.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
3.f	(4) Speedbrake deployed buffet.	The FSTD test results should exhibit the overall appearance and trends of the aeroplane data, with at least three of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Flight.		✓	✓		The test condition should be at a typical speed for a representative buffet.
3.f	(5) Stall buffet.	The FSTD test results should exhibit the overall appearance and trends of the aeroplane data, with at least three of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Cruise (high altitude), and approach or landing.		✓	✓		Tests should be conducted for approach to stall at angles of attack between the initial buffet and the critical angle of attack. Post stall characteristics are not required. If stabilized flight data between initial buffet and stall speed are not available, PSD analysis should be conducted for the time span between initial buffet and stall speed. *Note.— The test is not required if the aeroplane does not exhibit buffet before reaching the critical angle of attack.*
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 of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Flight.		✓	✓		The 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 of the predominant frequency “spikes” being present within ±2 Hz of the aeroplane data.	Flight in clean configuration.		✓	✓		The test should be conducted to be representative of in-flight vibrations for propeller-driven aeroplanes.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
4.	VISUAL SYSTEM	The validation tests in this section have a dependency upon the following simulation features: visual cue; and environment — Airports and terrain. 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 have the appropriate combination of fidelity levels for these two device features. This must be accounted for when checking the operational system. This is well defined in Part II as it is applicable to a device type, but for the solution possibilities in Part III potential implications of choice of fidelity level must be taken into account.						
4.a	**Visual scene quality**							
4.a.1	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.	Not applicable.				✓	Field of view should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares. Installed alignment should be confirmed in an SOC (this would generally consist of results from acceptance testing).
	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.	Not applicable.			✓		Field of view should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares. Installed alignment should be confirmed in an SOC (this would generally consist of results from acceptance testing).
	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.	Not applicable.	✓				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°.	Not applicable.				✓	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.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
4.a.2.a.2	System geometry — Absolute geometry.	Within the central 200° x 40°, all points on a 5-degree grid should fall within 3° of the design position as measured from each pilot eyepoint.	Not applicable.				✓	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.	Not applicable.				✓	For a diagram showing zones 1, 2 and 3 and further discussion of this test, see Part II, Appendix B, 3.6.3.3. *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		✓		✓		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
4.a.3	Surface resolution (object detection).	Not greater than 2 arc minutes.	Not applicable.				✓	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 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.				✓		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	Light-point size.	Not greater than 5 arc minutes.	Not applicable.				✓	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.				✓		
4.a.5	Raster surface contrast ratio. (ctd next page)	Not less than 5:1.	Not applicable.	✓		✓	✓	Surface contrast ratio should be measured using a raster drawn test pattern filling the entire visual scene (all channels). The test pattern should consist of black and white squares, 5° per square, with a white square in the centre of each channel. Measurement should be made on the centre bright square for each channel using a 1° spot photometer. This value should have a minimum brightness of 7 cd/m^2 (2 ft-lamberts). Measure any adjacent dark squares.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
4.a.5	Raster surface contrast ratio. (ctd)							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	Light-point contrast ratio.	Not less than 25:1.	Not applicable.				✓	Light-point contrast ratio should be measured using a test pattern demonstrating an area of greater than 1° area filled with white light points 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.				✓		
4.a.7	Light-point brightness.	Not less than 20 cd/m^2 (5.8 ft-lamberts).	Not applicable.			✓	✓	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, see Part II, Appendix B, 3.6.5. 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/m^2 (5.8 ft-lamberts) on the display.	Not applicable.				✓	Surface brightness should be measured on a white raster, measuring the brightness using the 1° spot photometer.
		Not less than 14 cd/m^2 (4.1 ft-lamberts) on the display.				✓		Light points are not acceptable. Use of calligraphic capabilities to enhance raster brightness is acceptable.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
4.a.9	Black level and sequential contrast.	Black intensity: Background brightness — Black polygon brightness < 0.015 cd/m^2 (0.004 ft-lamberts). Sequential contrast: Maximum brightness — (Background brightness — Black polygon brightness) > 2 000:1.	Not applicable.				✓	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 minutes or less.	Not applicable.				✓	A test pattern consists of an array of 5 peak white squares with black gaps between them of decreasing width. The range of black gap widths should at least extend above and below the required detectable gap, and be in steps of 1 arc minutes. 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 CAA 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%.	Not applicable.				✓	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.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
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 minutes.	Not applicable.				✓	Alignment requirement applies to any HUD system in use or both simultaneously if they are used simultaneously for training.
						✓		Alignment requirement only applies to the pilot flying. R — excluding PPL and CPL.
4.b.2	System display.	All functionality in all flight modes should be demonstrated.				✓	✓	A statement of the system capabilities should be provided and the capabilities demonstrated. R — excluding PPL and CPL.
4.b.3	HUD attitude versus FSTD attitude indicator (pitch and roll of horizon).	Pitch and roll align with aircraft instruments.	Flight.			✓	✓	For level R devices, alignment requirement only applies to the pilot flying. R — excluding PPL and CPL.
4.c	**Enhanced Flight Vision System (EFVS)**							
4.c.1	Registration test.	Alignment between EFVS display and out-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).				✓	*Note.— The effects of the alignment tolerance in 4.b.1 should be taken into account.*
						✓		Alignment requirement only applies to the pilot flying. *Note.— The effects of the alignment tolerance in 4.b.1 should be taken into account.* R — excluding PPL and CPL.
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.			✓	✓	Infra-red scene representative of both 350 m (1 200 ft), and 1 609 m (1 sm) RVR. Visual scene may be removed. R — excluding PPL and CPL.
4.c.3	Thermal crossover.	Demonstrate thermal crossover effects during day to night transition.	Day and night.			✓	✓	The scene will correctly represent the thermal characteristics of the scene during a day to night transition. R — excluding PPL and CPL.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
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 an RVR setting of 300 m (1 000 ft) or 350 m (1 200 ft).			✓	✓	This test is designed to assess items impacting the accuracy of the visual scene presented to a pilot at DH on an ILS approach. These items include: — RVR/visibility; — glide slope (G/S) and localizer modelling accuracy (location and slope) for an ILS; — for a given mass, configuration and speed representative of a point within the aeroplane's operational envelope for a normal approach and landing; and — radio altimeter. If a generic aeroplane is used as the basic model, a generic cut-off angle of 15˚ is assumed as an ideal. *Note.— If non-homogeneous fog is used, the vertical variation in horizontal visibility should be described and included in the slant range visibility calculation used in the VGS computation.* R — excluding PPL and CPL.
4.e	**Visual system capacity**							
4.e.1	System capacity — Day mode.	Not less than: 10 000 visible textured surfaces, 6 000 light points, 16 moving models.	Not applicable.			✓	✓	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.			✓	✓	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.	✓				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. Applies when used to support MPL1, MPL2 or IR training, applications allowing the use of a reduced FOV visual system.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5	SOUND SYSTEMS							Sound tests with a fidelity level of R have been divided into three sub-categories: RA — which covers: (T): MPL4, Re; and (TP): MPL4, TR, ATPL, RO, IO, CQ, RL. RB — which covers: (T): MPL3, ATPL, TR, IO, RO, RL; and (TP): MPL3. RC — which covers: (T): MPL2; and (TP): MPL2. The following table will refer to RA, RB and RC for convenience.
5.a	**Turbo-jet/Turbo-fan aeroplanes**							All tests in sub-category levels RA and RB of this section should be presented using an unweighted 1/3 octave band format from at least bands 17 to 42 (50 Hz to 16 kHz). A measurement of minimum 20 s should be taken at the location corresponding to the approved dataset. The approved dataset and FSTD results should be produced using comparable data analysis techniques. See Part II, Appendix B, 3.7. For level RC devices, tests in this section may be presented as a single overall SPL level.

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
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.			✓ RA		Normal condition prior to engine start. The APU should be on if appropriate. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.a	(2) All engines at idle.	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.			✓ RA		Normal condition prior to take-off. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.a	(3) All engines at maximum allowable thrust with brakes set.	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.			✓ RA		Normal condition prior to take-off. This test is intended to check the maximum stabilized allowable thrust with brakes set, without jeopardizing the aeroplane and safety. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.a	(4) Climb.	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.	En-route climb.			✓ RA		Medium altitude. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.a	(5) Cruise.	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.	Cruise.			✓ RA		Normal cruise configuration. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.a	(6) Speed brake/spoilers extended (as appropriate).	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.	Cruise.			✓ RA		Normal and constant speed brake deflection for descent at a constant airspeed and power setting. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.a	(7) Initial approach.	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.	Approach.			✓ RA		Constant airspeed, gear up, flaps/slats as appropriate. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.a	(8) Final approach.	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.	Landing.			✓ RA		Constant airspeed, gear down, landing configuration flaps. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.b	**Propeller-driven aeroplanes**							All level RA and RB tests in this section should be presented using an unweighted 1/3 octave band format from at least bands 17 to 42 (50 Hz to 16 kHz). A measurement of minimum 20 s should be taken at the location corresponding to the approved dataset. The approved dataset and FSTD results should be produced using comparable data analysis techniques. See Part II, Appendix B, 3.7. For level RC devices, tests in this section may be presented as a single overall SPL level.
5.b	(1) Ready for engine start. (ctd next page)	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.			✓ RA		Normal condition prior to engine start. The APU should be on if appropriate. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.b	(1) Ready for engine start. (ctd)	Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		
5.b	(2) All propellers feathered, if applicable.	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.			✓ RA		Normal condition prior to take-off. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.b	(3) Ground idle or equivalent.	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.			✓ RA		Normal condition prior to take-off. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.b	(4) Flight idle or equivalent.	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.			✓ RA		Normal condition prior to take-off. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.b	(5) All engines at maximum allowable power with brakes set.	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.			✓ RA		Normal condition prior to take-off. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.b	(6) Climb.	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.	En-route climb.			✓ RA		Medium altitude. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.b	(7) Cruise.	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.	Cruise.			✓ RA		Normal cruise configuration. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.b	(8) Initial approach.	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.	Approach.			✓ RA		Constant airspeed, gear up, flaps extended as appropriate, RPM as per operating manual. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.b	(9) Final approach.	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.	Landing.			✓ RA		Constant airspeed, gear down, landing configuration flaps, RPM as per operating manual. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.c	**Special cases**	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.				✓ RA		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. For level RA devices, it would be acceptable to have some 1/3 octave bands out of ±5 dB 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. For level RA devices, where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations. For level RA and RB devices, tests in this section should be presented using an unweighted 1/3 octave band format from at least bands 17 to 42 (50 Hz to 16 kHz). A measurement of minimum 20 s should be taken at the location corresponding to the approved dataset. The approved dataset and FSTD results should be produced using comparable data analysis techniques. See Part II, Appendix B, 3.7. For level RC devices, tests in this section may be presented as a single overall SPL level.
		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.				✓ RB		
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
5.d	**FSTD background noise**	Initial evaluation: background noise levels should fall below the plot in Figure B-10 of Part II, Appendix B. Recurrent evaluation: ±3 dB per 1/3 octave band compared to initial evaluation.				✓ RA RB		Results of the background noise at initial qualification should be included in the QTG document and approved by the qualifying CAA. The simulated sound will be evaluated to ensure that the background noise does not interfere with training. See Part II, Appendix B, 3.7.7. The measurements are to be made with the simulation running, the sound muted and a dead cockpit. For level RA and RB devices, this test should be presented using an unweighted 1/3 octave band format from bands 17 to 42 (50 Hz to 16 kHz). For level RC devices, this test may be presented as a single overall SPL level.
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		
5.e	**Frequency response**	Initial evaluation: not applicable. 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 (static with all systems switched off).			✓ RA RB		Only required if the results are to be used during recurrent evaluations according to Part II, Appendix B, 3.7.8. The results should be acknowledged by the CAA during the initial qualification. For level RA and RB devices, this test should be presented using an unweighted 1/3 octave band format from bands 17 to 42 (50 Hz to 16 kHz).
		Initial evaluation: not applicable. Recurrent evaluation: ±3 dB SPL RMS compared to initial evaluation.				✓ RC		For level RC devices, this test should be run at three frequencies (high, mid-range and low).

	Test	Tolerance	Flight Condition	G	R1	R	S	Comments
6	SYSTEM INTEGRATION							
6.a	**System response time**							
	(1) Transport delay.	Motion system response: 100 ms or less after controller movement.	Pitch, roll and yaw.		✓	✓		A separate test is required in each axis. Motion system test where system installed.
		Visual system response: 120 ms or less after controller movement.				✓	✓	A separate test is required in each axis. Where EFVS systems are installed, the EFVS response should be within ±30 ms from visual system response, and not before motion system response. *Note.— The delay from aeroplane EFVS electronic elements should be added to the 30 ms tolerance before comparison with visual system reference as described in Part II, Attachment G.* R — excluding CR, CPL and PPL. S — excluding MPL3.
		Instruments system response: 100 ms or less after controller movement.					✓	
		Visual system response: 200 ms or less after controller movement.		✓		✓	✓	A separate test is required in each axis. R — only for CR, CPL and PPL. S — only for MPL3.
		200 ms or less after controller movement.		✓		✓		A separate test is required in each axis. R — excluding motion and visual systems.

Appendix C

FUNCTIONS AND SUBJECTIVE TESTS

1. INTRODUCTION

1.1 Accurate replication of aeroplane systems functions should be checked at each flight crew member position. This includes procedures using the AFM and checklists. Handling qualities, performance and FSTD systems operation as they pertain to the actual aeroplane, as well as FSTD cueing (e.g. visual cueing and motion cueing) and other supporting systems (e.g. IOS), should be subjectively assessed. Prior coordination with the CAA responsible for the evaluation is essential to ensure that the functions tests are conducted in an efficient and timely manner and that any skills, experience or expertise required by the evaluation team are available.

1.2 The necessity of functions and subjective tests arises from the need to confirm that the simulation has produced a totally integrated and acceptable replication of the aeroplane. Unlike the objective tests listed in Appendix B, subjective testing should cover areas of the flight envelope that may reasonably be reached by a trainee. Like the validation tests, the functions 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 FSTD operator should have 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 CAA evaluator(s).

1.3 At the request of an FSTD operator, the FSTD may be assessed for a special aspect of a relevant training programme during the functions and subjective portion of an evaluation. Such an assessment may include a portion of a line-oriented flight training (LOFT) scenario or special emphasis items in the training programme. Unless directly related to a requirement for the current qualification level, the results of such an evaluation would not affect the FSTD's current qualification status.

1.4 Functions tests should be run in a logical flight sequence at the same time as performance and handling assessments. This also permits the FSTD to run for two to three hours in real time, without repositioning of flight or position freeze, thereby permitting proof of reliability. A useful source of guidance for conducting the functions and subjective tests is published in the RAeS *Aeroplane Flight Simulator Evaluation Handbook*, Volume II (see Part II, Chapter 2, 2.3).

1.5 The FSTD should be assessed to ensure that repositions, resets and freezes support efficient and effective training.

1.6 At the time of writing, simulated ATC environment was still in the early stages of its development and adoption. As a result, training approval and device qualification for this subject has not yet been proven by experience. Until such a time, it is envisaged that the evaluation of FSTD simulated ATC environment capability will be conducted via training approval and not as part of FSTD qualification.

1.7 The FSTD should be assessed to ensure that simulated ATC environment supports the specific training task (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 high fidelity synthetic representation of real-world operations.

1.8 Since the requirements for simulated ATC environment are intentionally non-prescriptive, assessment will be largely subjective. The qualification of the FSTD should not be withheld, restricted or simulated ATC environment annotated as a “non-qualified task” as a result of non-compliance. However, if the system does not meet the criteria of a largely subjective evaluation, the training task should not be approved.

1.9 Further guidance on approval and qualification will be published in subsequent updates or amendments to this document when sufficient experience has been gathered by industry.

2. TEST REQUIREMENTS

2.1 The ground and flight tests and other checks required for qualification are listed in the following Table of Functions and Subjective Tests. The table includes manoeuvres and procedures (both conventional and performance-based navigation) to ensure that the FSTD functions and performs appropriately for use in pilot training and testing or checking in the manoeuvres and procedures normally required of an approved training programme.

2.2 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.

2.3 A representative selection of 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 ensure appropriate attention to system checks.

3. TABLE OF FUNCTIONS AND SUBJECTIVE TESTS

Note 1.— The Functions and Subjective Tests are all executed in an environment where FSTD features are used in a fully integrated manner. The integrated nature of the testing environment prevents these functions and subjective tests from being classified by feature fidelity level. Where any new type of FSTD is created, it will inevitably have a collection of different feature fidelity levels in its construction, which precludes the possibility of classifying tests for those "device types" using the categories G, R and S. To avoid the possibility of confusion by associating function and subjective tests for those "device types" with G, R and S, the feature fidelity levels are not presented in this table. Instead, the complete Functions and Subjective Tests list as used in Part II, Appendix C is provided with a single blank column under the heading "Applicability". For any new device type created, an appropriate Functions and Subjective Tests list will have to be defined from this master list. This should be done by analysis of the applicable training tasks that the device will support as presented in Part I and by entering ticks in the "Applicability" column for appropriate test cases. This list will have to be agreed with the relevant CAA. Examples of this can be seen in Part II, Appendix C where similar exercises were conducted for device Types I to VII.

Note 2.— "Other" means any other test as applicable to the aeroplane being simulated and as applicable to the FSTD type.

Number	Functions and Subjective Tests	Applicability
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 that of the aeroplane being simulated.	
1.a.2	The flight deck design and functions represent those of the simulated class of aeroplanes.	
1.a.3	The flight deck design and functions are aeroplane-like and generic but recognizable as within a class of aeroplanes.	
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).	

Number	Functions and Subjective Tests	Applicability
2.b.7	Low visibility (taxi route, signage, lighting, markings, etc.).	
2.c	**Brake operation.**	
2.c.1	Normal, automatic and alternate/emergency operation.	
2.c.2	Brake fade.	
2.d	Other.	
3	**TAKE-OFF.** *Note.— Only those take-off tests relevant to the type or class of the 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 (maximum demonstrated).	
3.a.4	Special performance:	
3.a.4.a	Reduced $V_{1.}$	
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.	
3.a.4.e	Obstacle (performance over visual obstacle).	
3.a.5	Low visibility take-off.	
3.a.6	Landing gear, wing flap and leading edge device operation.	
3.a.7	Contaminated runway operations.	
3.a.8	Other.	
3.b	**Abnormal/emergency.**	
3.b.1	Rejected take-off.	
3.b.2	Rejected special performance take-off (e.g. reduced V1, maximum engine de-rate, soft field, short field/short take-off and landing (STOL) operations, etc.).	
3.b.3	Rejected take-off with contaminated runway.	
3.b.4	Continued take-off with failure of most critical engine at most critical point.	
3.b.5	Flight control system failures, reconfiguration modes, manual reversion and associated handling.	
3.b.6	Other.	

Number	Functions and Subjective Tests	Applicability
4	**CLIMB.**	
4.a	Normal.	
4.b	One or more engine(s) 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 V_{mo} or M_{mo}).	
5.a.6	High-IAS handling.	
5.a.7	Other.	
5.b	**Manoeuvres.**	
5.b.1	High angle of attack, approach to stall, stall warning, buffet, g-break/pitch break and stick pusher response (take-off, cruise, approach and landing configuration). Aeroplane automation (such as autopilot and autothrottle) response to stall warning, stall and stick pusher.	
5.b.2	Slow flight.	
5.b.3	Upset recognition and recovery manoeuvres within the FSTD's validated envelope as defined on the statement of compliance (see Part II, Attachment P).	
5.b.4	Flight envelope protection (high angle of attack, bank limit, overspeed, etc.).	
5.b.5	Turns with/without speedbrake/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.	
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.	

Number	Functions and Subjective Tests	Applicability
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.14.c	Eights on pylons (visual resolution).	
5.b.14.d	Turns about a point.	
5.b.14.e	S-turns about a road or section line.	
5.b.15	Other.	
6	**DESCENT.**	
6.a	Normal.	
6.b	Maximum rate/emergency (clean, with speedbrakes, 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 type or class of the aeroplane being simulated should be selected from the following list, where tests should be made with limiting wind velocities, wind shear (except for the CAT II and 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.	
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.	

Number	Functions and Subjective Tests	Applicability
7.a.3	**CAT III published approaches.**	
7.a.3.a	Autopilot/autothrottle coupled approach to landing and roll-out (if applicable) guidance (manual and autoland).	
7.a.3.b	Autopilot/autothrottle coupled approach to DH and go-around (manual and autopilot).	
7.a.3.c	Autopilot/autothrottle coupled approach to land and roll-out (if applicable) guidance with one engine inoperative (manual and autoland).	
7.a.3.d	Autopilot/autothrottle coupled approach to DH and go-around 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 maximum crosswind component demonstrated or authorized.	
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, 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) — localizer performance (LP) and lateral navigation (LNAV) minima (at nominal and minimum authorized temperatures), all engine(s) operating and with one or more engine(s) inoperative.	
7.b.5	ILS localizer only (LOC), and ILS localizer back course (LOC-BC) approaches (with and without CDFA), all engine(s) operating and with one or more engine(s) inoperative.	
7.b.6	ILS offset localizer approach, all engine(s) operating and with one or more engine(s) inoperative.	
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.	

Number	Functions and Subjective Tests	Applicability
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 engine(s) inoperative.	
8.c	Operation of landing gear, flap/slats and speedbrakes (normal and abnormal).	
8.d	Approach and landing with crosswind (maximum demonstrated crosswind component).	
8.e	Approach and landing with flight control system failures (for reconfiguration modes, manual reversion and associated handling with the most significant degradation which is probable).	
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.	
8.k	Approach and landing from published visual approach (including those that use PBN)	
8.l	Other.	
	Note.— An FSTD with a visual system, which permits completing a special approach procedure in accordance with applicable regulations, may be approved for that particular approach procedure.	

Number	Functions and Subjective Tests	Applicability
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 and anti-skid operation with dry conditions.	
10.a.6.d	Auto-braking system operation.	
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 engine systems operation (where fitted).**	
11.a.1	Air conditioning and pressurisation (Environmental Control System).	
11.a.2	De-icing/anti-icing.	
11.a.3	Auxiliary engine/auxiliary power unit (APU).	
11.a.4	Communications.	
11.a.5	Electrical.	
11.a.6	Fire and smoke detection and suppression.	

Number	Functions and Subjective Tests	Applicability
11.a.7	Flight controls (primary and secondary).	
11.a.8	Fuel and oil.	
11.a.9	Hydraulic.	
11.a.10	Pneumatic.	
11.a.11	Landing gear.	
11.a.12	Oxygen.	
11.a.13	Engine.	
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. 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 systems.	
11.a.20	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 and emergency procedures).	
11.a.27	Runway alerting and advisory system.	
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	**Wind shear:**	
11.b.3.a	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.	

Number	Functions and Subjective Tests	Applicability
12	**VISUAL SYSTEM.** This section is written in the context of the FSTD operator presenting models of real-world airports, serviced by the aeroplane type being simulated, for use in completion of the functions and subjective tests described in this appendix. 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 FSTD operator 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 CAA may select any visual scene used in the air operator's training programme(s) for completion of the functions and subjective tests, provided these visual scenes were modelled with the features required.	
12.a	**Functional test content requirements.** The following are the minimum airport model content requirements to satisfy visual capability tests, and provide suitable visual cues to allow completion of all functions and subjective tests described in this appendix. FSTD operators are encouraged to use the model content described below for the functions and subjective tests.	
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 real-world airport model to be consistent with published data used for aeroplane operations. This model should be acceptable to the FSTD operator's CAA and selectable from the IOS.	
12.a.1.c	A minimum of one generic airport model to be consistent with published data used for aeroplane operations. This model should be acceptable to the FSTD operator's CAA 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.	

Number	Functions and Subjective Tests	Applicability
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.	
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.	

Number	Functions and Subjective Tests	Applicability
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 authorized in low visibility. The designated runway and taxi routing should be consistent with that airport for operations in low visibility.	
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 correlated with the displayed runway surface and lighting.	
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.	

Number	Functions and Subjective Tests	Applicability
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	Representative moving airborne traffic (including the capability to present air hazards, e.g. airborne traffic on a possible collision course).	
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.	
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.	

Number	Functions and Subjective Tests	Applicability
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	Dynamic effects — the capability to present multiple ground and air hazards such as another aeroplane crossing the active runway or converging airborne traffic; hazards should be selectable via controls at the instructor station.	
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).	
12.e.5	The effect of rain removal devices should be provided.	

Number	Functions and Subjective Tests	Applicability
12.f	**Scene quality.**	
12.f.1	**Quantization.**	
12.f.1.a	Surfaces and textural cues should be free from apparent quantization (aliasing).	
12.f.1.b	Surfaces and textural cues should not create distracting quantization (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.	

Number	Functions and Subjective Tests	Applicability
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.	
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 recognize an event or situation. Where applicable below, the FSTD pitch, side loading and directional control characteristics, as well as the vibration 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 centre line lights, runway contamination with associated anti-skid and taxiway characteristics.	
13.c	Buffets on the ground due to spoiler/speedbrake extension and thrust reversal.	
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/speedbrake extension.	
13.g	Buffet due to atmospheric disturbances.	
13.h	Approach to stall buffet.	
13.i	Touchdown cues for main and nose gear.	
13.j	Nosewheel scuffing.	
13.k	Thrust effect with brakes set.	
13.l	Mach and manoeuvre buffet.	
13.m	Tire failure dynamics.	
13.n	Engine failures, malfunction, engine and airframe structural damage.	
13.o	Tail, engine pod/propeller, wing strikes.	
13.p	Other.	
14	**SOUND SYSTEM.**	
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.	

Number	Functions and Subjective Tests	Applicability
14.d	Abnormal operations for which there are associated sound cues including, but not limited to, engine malfunctions, landing gear/tire malfunctions, tail and engine pod/propeller strike and pressurization malfunctions.	
14.e	Sound of a crash when the FSTD is landed in excess of limitations.	
15	**SPECIAL EFFECTS.**	
15.a	Braking dynamics (normal and anti-skid, failure dynamics for brakes and anti-skid, reduced efficiency due to high temperature, etc.).	
15.b	Effects of airframe and engine icing.	
16	**SIMULATED AIR TRAFFIC CONTROL (ATC) ENVIRONMENT.** *Note 1.— Automated simulation of standard ATC communications to the ownship is not mandated by this document, but is nevertheless strongly recommended. If the FSTD operator has elected to use the instructor to provide all ATC communications to the ownship, the evaluator will need to review the following functions list taking this into consideration.* *Note 2.— 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	**Automated weather reporting.**	
16.a.2.a	Multiple stations	
16.a.2.b	Single station	
16.a.3	**Message format and regional characteristics.**	
16.a.3.a	Regional.	
16.a.3.b	ICAO message format.	
16.a.4	Provided by data link.	
16.b	**Other traffic.**	
16.b.1	**Aircraft behaviour.**	
16.b.1.a	Airport specific.	
16.b.1.b	Aircraft behaviour.	
16.b.1.b.1	Appropriate routing.	
16.b.1.b.2	Representative performance.	
16.b.2	Airport clutter.	
16.b.3	**Traffic flow and separation.**	
16.b.3.a	Scalable, if required.	
16.b.3.b	Sufficient intensity, representative separation.	

Number	Functions and Subjective Tests	Applicability
16.b.4	Traffic type (airport specific).	
16.b.5	Traffic call sign and livery.	
16.b.6	Runway incursion.	
16.c	**Background radio traffic.**	
16.c.1	**Background radio traffic.**	
16.c.1.a	No obviously erroneous information.	
16.c.1.b	Frequency specific messages.	
16.c.1.c	No overstepping (normally).	
16.c.1.d	Reasonable frequency access.	
16.c.2	**Other traffic radio communications.**	
16.c.2.a	Intrusive, if required.	
16.c.2.b	Non-intrusive.	
16.c.3	**ATC radio communications.**	
16.c.3.a	Location-specific procedures and nomenclature.	
16.c.3.b	**ATC radio communications.**	
16.c.3.b.1	Consistent with other traffic movements.	
16.c.3.b.2	Continuous across sector boundaries.	
16.c.3.b.3	ICAO standard phraseology (as per Doc 4444, PANS-ATM).	
16.c.4	**Overstepping on frequency.**	
16.c.4.a	Basic ATC notification.	
16.c.4.b	Indication at the IOS.	
16.d	**Airport and airspace modelling.**	
16.d.1	**Simulated ATC environment modelled areas.**	
16.d.1.a	Sufficient specific models.	
16.d.1.b	Sufficient generic models.	
16.d.2	Runways.	
16.d.2.a	Multiple.	
16.d.2.b	Single.	
16.d.3	Data synchronization.	
16.e	**Weather.**	
16.e.1	Reference runway.	
16.e.2	Other traffic separation.	
16.e.3	Low visibility operations.	

Number	Functions and Subjective Tests	Applicability
16.f	**ATC — ownship communications.**	
16.f.1	Time synchronization.	
16.f.2	ATC radio communications.	
16.f.3	**Message triggering.**	
16.f.3.a	Automatic.	
16.f.3.b	Manual.	
16.f.4	“Standby” and “say again”.	
16.f.5	Readback and acknowledgements.	
16.f.6	Clearance deviations.	
16.g	**Language and phraseology.**	
16.g.1	English.	
16.g.2	Standard phraseology.	
16.h	**Ownship radio operation.**	
16.h.1	Multi-frequency radio operation.	
16.i	**System correlation.**	
16.i.1	Visual system.	
16.i.2	TCAS.	
16.i.3	Cockpit traffic displays, if installed.	
16.i.4	IOS.	
16.j	**Data link communications.**	
16.j.1	ATS clearances.	
16.j.2	ATS weather.	
16.j.3	DLIC.	
16.j.4	Connection management.	
16.j.5	CPDLC.	
16.j.6	ADS-C.	
16.j.7	AOC/DSP.	
16.j.8	Service failures.	
16.k	**ATC voice characteristics.**	
16.k.1	**Voice assignment.**	
16.k.1.a	Multiple ATC voices.	
16.k.1.b	Single ATC voice.	
16.k.2	Gender and accents.	

Number	Functions and Subjective Tests	Applicability
16.l	**Instructor controls.**	
16.l.1	Access to radio communications.	
16.l.2	Simulator functions.	
16.l.3	Disable.	
16.l.4	Mute (background radio traffic).	
16.m	Other.	
17	**INSTRUCTOR OPERATING STATION.**	
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.**	
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.	

Number	Functions and Subjective Tests	Applicability
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, cg, 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).	

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