

Aeroplane and Rotorcraft Simulator Manual

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TABLE OF CONTENTS

TABLE OF CONTENTS	III
CHAPTER 1 - INTRODUCTION	1-1
1.1 Purpose	1-1
1.2 Applicability	1-1
1.3 Description of Changes	1-1
1.4 Reference Documents	1-1
1.5 Definitions and Abbreviations	1-1
CHAPTER 2 - POLICIES AND PROCEDURES	2-1
2.1 Flight Simulation Training Device Use	2-1
2.2 Manager of Simulator Program Responsibilities	2-1
2.3 Training Program Approval Authority Responsibilities	2-2
2.4 Evaluation Types	2-2
2.5 Qualification Performance Standards	2-3
2.6 Sponsor Eligibility	2-4
2.7 Additional Responsibilities of the Sponsor	2-5
2.8 Compliance Processes	2-5
2.9 FSTD Performance Degradation and Discrepancy Reporting	2-7
2.10 Simulator Component Inoperative Guide and Operation with missing, malfunctioning, or inoperative components	2-7
2.11 Loss or partial loss of qualification	2-8
2.12 Notification of qualification loss	2-9
2.13 Qualification restoration procedures	2-9
2.14 FSTD objective data requirements	2-10
2.15 Interim qualification of FSTDs for new aircraft types or models	2-10
2.16 Modifications to FSTDs	2-11
2.17 FSTD qualification based on a Bilateral Aviation Safety Agreement	2-11
ATTACHMENT 2-1 – SIMULATOR COMPONENT INOPERATIVE GUIDE	2-13
Table 2-1 – Example of Simulator Component Inoperative Guide	2-15
CHAPTER 3 - SPONSOR ADMINISTRATIVE PROCEDURES - APPLICATIONS AND NOTIFICATIONS	3-1
3.1 General	3-1
3.2 Acceptance of Validation Data	3-1
3.3 Application for Initial or Upgrade Evaluations	3-2
3.4 Notification of FSTD Modifications and updates	3-4
3.5 Application for Foreign Evaluations	3-5
3.6 Application for Interim Qualification	3-6
3.7 Additional qualifications for a currently qualified FSTD	3-8
3.8 Continuing FSTD Qualification	3-8
3.9 Voluntary Suspension	3-9
3.10 Application for an FSTD Qualification under a Bilateral Aviation Safety Agreement (BASA)	3-9
CHAPTER 4 - FULL FLIGHT SIMULATOR - QUALIFICATION PERFORMANCE STANDARDS	4-1
4.1 Overview	4-1
4.2 Flight Test Validation Data	4-1
4.3 Engineering Simulator—Validation Data	4-2
4.4 Validation Test Tolerances - Non-Flight-Test Data	4-4
4.5 Validation Data Roadmap	4-4
4.6 Acceptance Guidelines for Alternative Avionics (Flight-Related Computers and Controllers)	4-5
4.7 Control Dynamics	4-6
4.8 Ground Effect (Aeroplane Full Flight Simulator Only)	4-13
4.9 Motion Systems	4-13

4.10	Sound System	4-15
4.11	Transport Delay Testing	4-17
4.12	Visual Display Systems	4-20
4.13	Visual Scene Requirements	4-24
4.14	Initial (and Upgrade) Qualification Requirements	4-26
4.15	Alternative Data Sources, Procedures, and Instrumentation: Level A and Level B Simulators Only	4-28
4.16	Objective Test Requirements	4-30
4.17	Subjective Testing Discussion	4-32
4.18	Conduct of Initial and Upgrade Evaluations	4-33
4.19	Continuing Qualification Evaluations and Requirements	4-35
APPENDIX A1 - AEROPLANE FFS – GENERAL SIMULATOR REQUIREMENTS		4-37
	Table A1A – Aeroplane - Minimum Simulator Requirements	4-38
	Table A1B - Tasks vs. Simulator Level – Subjective Requirements	4-51
	Table A1C – Aeroplane - Table of Simulator System Tasks – Subjective Requirements	4-54
APPENDIX A2 - AEROPLANE FFS – OBJECTIVE TESTS		4-55
	Introduction	4-55
	Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests	4-56
	Table A2B – Aeroplane Alternative Data Sources, Procedures, and Instrumentation (Level A and B FSTDs)	4-122
4.	Acceptance Guidelines for Alternative Engines Data	4-130
	Table A2C - Aeroplane Alternative Engine Validation Flight Tests	4-131
APPENDIX A3 – AEROPLANE FFS – SIMULATOR SUBJECTIVE EVALUATION		4-132
	Table A3A – Aeroplanes - Functions and Subjective Tests – Operations Tasks	4-132
	Table A3B – Aeroplane Class I Airport Models - Functions and Subjective Tests	4-137
	Table A3C – Aeroplane Class II Airport Models - Functions and Subjective Tests	4-141
	Table A3D – Aeroplane - Functions and Subjective Tests – Motion System	4-144
APPENDIX B1 – ROTORCRAFT FFS – GENERAL SIMULATOR REQUIREMENTS		4-147
	Table B1A –Rotorcraft - Minimum Simulator Requirements	4-148
	Table B1B - Rotorcraft - Tasks vs Simulator Level –Subjective Requirements	4-159
APPENDIX B2 – ROTORCRAFT FFS - OBJECTIVE TESTS		4-162
	Introduction	4-162
	Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests	4-163
	Table B2B - Alternative Data Sources, Procedures, and Instrumentation – Level B FSDTs only	4-204
APPENDIX B3 – ROTORCRAFT FFS - SIMULATOR SUBJECTIVE EVALUATION		4-208
	Table B3A – Rotorcraft - Functions and Subjective Tests – Operations Tasks	4-208
	Table B3B – Rotorcraft Class I Airport Models or Landing Area Models - Functions and Subjective Tests	4-213
	Table B3C – Rotorcraft Class II Airport or Landing Area Models - Functions and Subjective Tests	4-218
	Table B3D – Rotorcraft - Functions and Subjective Tests – Motion System	4-220
	Table B3E – Rotorcraft - Sound System - Functions and Subjective Tests	4-223
	Table B3F – Rotorcraft – Special Effects - Functions and Subjective Tests	4-223
	Table B3G – Rotorcraft – Instructor Operating System (IOS) - Functions and Subjective Tests	4-224
ATTACHMENTS TO CHAPTER 4		4-225
	Attachment 4.1 - Sample Validation Data Roadmap (VDR)	4-225
	Attachment 4.2 – Guidance for planning Functions and Subjective Testing	4-227
CHAPTER 5 - TYPE-SPECIFIC FLIGHT TRAINING DEVICE (FTD) - QUALIFICATION PERFORMANCE STANDARDS		5-1
5.1	Overview	5-1
5.2	General Description of Type-Specific Flight Training Device	5-1
5.3	Flight Test Validation Data	5-2
5.4	Engineering Simulator—Validation Data	5-3
5.5	Validation Test Tolerances - Non-Flight-Test Data	5-3
5.6	Validation Data Roadmap	5-4
5.7	Acceptance Guidelines for Alternative Avionics (Flight-Related Computers and Controllers)	5-4

5.8	Initial (and Upgrade) Qualification Requirements	5-5
5.9	Flight Training Device Level 5, 6 and 7 - Subjective Testing	5-7
5.10	Flight Training Device Level 4 – Subjective Evaluation Method	5-8
5.11	Conduct of Initial and Upgrade Evaluations	5-9
5.12	Continuing Qualification Evaluations and Requirements	5-11
APPENDIX C1 – AEROPLANE TYPE-SPECIFIC FLIGHT TRAINING DEVICE – GENERAL SIMULATOR REQUIREMENTS		5-13
Table C1A – Aeroplane - Type-Specific Flight Training Device - Minimum Flight Training Device Requirements		5-14
Table C1B - Aeroplane Type-Specific FTD - Tasks vs. FTD Level – Subjective Requirements		5-30
APPENDIX C2 – AEROPLANE TYPE-SPECIFIC FLIGHT TRAINING DEVICE – OBJECTIVE TESTS		5-33
Introduction		5-33
Table C2A – Aeroplane Type-Specific Flight Training Device Objective Tests		5-34
Small, Single and Multiengine Aeroplanes - FTD Level 5 - Alternative Objective Data		5-104
Table C2B – FTD Level 5 - Alternative Data Source for - Small, Single and Multi-Engine Aeroplanes		5-104
Aeroplane – Flight Training Device Level 6 - Alternative Data Sources, Procedures, and Instrumentation		5-109
Table C2C – Aeroplane – Flight Training Device Level 6 - Alternative Data Sources, Procedures, and Instrumentation ..		5-110
APPENDIX C3 – AEROPLANE TYPE-SPECIFIC FLIGHT TRAINING DEVICE –SUBJECTIVE EVALUATION.....		5-115
Table C3A – Aeroplane Type-Specific FTD - Functions and Subjective Tests – Operations Tasks		5-115
Table C3B – Aeroplane – FTD Level 7 - Airport Modeling Requirements - Functions and Subjective Tests		5-121
Table C3D – Aeroplane – FTD Level 7 - Functions and Subjective Tests - Sound and IOS Requirements		5-124
Table C3E– Aeroplane – FTD Level 4 - Functions and Subjective Tests		5-125
APPENDIX D1 – ROTORCRAFT TYPE-SPECIFIC FLIGHT TRAINING DEVICE – GENERAL SIMULATOR REQUIREMENTS.		5-130
Table D1A – Rotorcraft Type-Specific FTD - Minimum Simulator Requirements		5-131
Table D1B - Rotorcraft Type Specific Flight Training Device – Minimum Subjective Requirements - Task vs. Flight Training Device Level		5-137
APPENDIX D2 – ROTORCRAFT TYPE-SPECIFIC FLIGHT TRAINING DEVICE – OBJECTIVE TESTS		5-140
Introduction		5-140
Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests		5-141
APPENDIX D3 – ROTORCRAFT TYPE-SPECIFIC FLIGHT TRAINING DEVICE - SUBJECTIVE EVALUATION.....		5-167
Table D3A – Rotorcraft – FTD Level 5 to 7 - Functions and Subjective Tests		5-167
Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests		5-172
Table B3C – Rotorcraft - FTD Level 7 - Class I Airport and Landing Area Models - Functions and Subjective Tests		5-183
Table B3D – Rotorcraft - FTD Level 7 - Class II Airport and Landing Area Models - Functions and Subjective Tests ..		5-186
CHAPTER 6 - NON-TYPE-SPECIFIC FLIGHT TRAINING DEVICE - QUALIFICATION PERFORMANCE STANDARDS		6-1
6.1	Overview	6-1
6.2	Roles and Responsibilities.	6-1
6.3	General Description of Non-Type-Specific FTDs	6-2
6.4	Non-Type-Specific FTD Levels	6-3
6.5	General Design Standards	6-4
6.6	Data package	6-4
6.7	Visual System	6-5
6.8	Transport Delay	6-6
6.9	Testing/Evaluation	6-6
6.10	Initial (and Upgrade) Qualification Requirements	6-7
6.11	Application for Initial or Upgrade Evaluations.	6-7
6.12	Qualification Test Guide (QTG)	6-8
6.13	Notification of FTD Modifications and updates.	6-10
6.14	Conduct of Initial and Upgrade Evaluations	6-11
6.15	Continuing Qualification Evaluations and Requirements	6-12
APPENDIX E1 - AEROPLANE NON-TYPE-SPECIFIC FTD – GENERAL SIMULATOR REQUIREMENTS		6-14
Table E1A - Aeroplane - Non-Type-Specific FTD - Minimum FTD Requirements		6-15

Table E1B – Aeroplane - Non-Type-Specific FTD - Tasks vs. FTD Level – Subjective Requirements	6-33
APPENDIX E2 – AEROPLANE NON-TYPE-SPECIFIC FTD – OBJECTIVE TESTS	6-35
Table E2A – Aeroplane – Non-Type-Specific FTD - Objective Tests	6-36
APPENDIX E3 – AEROPLANE – NON-TYPE-SPECIFIC FTD –SUBJECTIVE EVALUATION.....	6-46
Table E3A – Aeroplane Type-Specific FTD - Functions and Subjective Tests – Operations Tasks.....	6-46
APPENDIX F1 – ROTORCRAFT NON-TYPE-SPECIFIC FTD – GENERAL SIMULATOR REQUIREMENTS.	6-55
Table F1A - Rotorcraft - Non-Type Specific FTD – General Requirement	6-56
APPENDIX F2 – ROTORCRAFT NON-TYPE-SPECIFIC FTD – OBJECTIVE TESTS	6-72
Table F2A – Rotorcraft – Non-Type Specific FTD – Objective Tests.....	6-72
APPENDIX F3 – ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION	6-100
Table F3A - Rotorcraft - Non-Type Specific FTD – Functions and Subjective Evaluation	6-100
ATTACHMENTS TO CHAPTER 6.....	6-116
Attachment 6.1 - Sample FTD Certificate for Regional Authorities.	6-116
Attachment 6.2 - Non-Type-Specific FTD Qualification Profile.....	6-117
CHAPTER 7 - EVALUATION CRITERIA AND REQUIREMENTS FOR ADDITIONAL QUALIFICATIONS	7-1
7.1 Overview	7-1
7.2 Aeroplane Full Flight Simulator - Qualification Requirements for Windshear Training Program Use	7-1
7.3 Aeroplane Full Flight Simulator - Qualification Requirements for Full Stall Training Tasks	7-3
7.4 Aeroplane Full Flight Simulator - Evaluation Requirements for Upset Prevention and Recovery Training Tasks.....	7-5
7.5 Aeroplane Full Flight Simulator - Evaluation Requirements for Engine and Airframe Icing Training Tasks	7-6
7.6 Aeroplane Full Flight Simulator - Evaluation Requirements for Takeoff and Landing in Gusting Crosswind	7-6
7.7 Aeroplane Full Flight Simulator - Evaluation Requirements for Bounced Landing Recovery Training Tasks	7-7
7.8 Aeroplane Full Flight Simulator - Procedures and Criteria for Assessing and Approving Circling Approaches .	7-7
APPENDIX G1 - ADDITIONAL SIMULATOR QUALIFICATION REQUIREMENTS FOR STALL, UPSET PREVENTION AND RECOVERY, AND ENGINE AND AIRFRAME ICING TRAINING TASKS	7-11

Chapter 1 - Introduction

1.1 Purpose

- 1.1.1 This manual contains the policy, procedures, performance standards and evaluation criteria used by the National Simulator Evaluation Program to evaluate and certify aeroplane and rotorcraft flight simulation training devices (FSTD) pursuant to section 606.03 of the Canadian Aviation Regulations (CARs).

1.2 Applicability

- 1.2.1 This manual applies to:
- Each person using or applying to use an FSTD to meet any requirement of Part IV, Part VI or Part VII of the CARs;
 - Eligible persons seeking to sponsor an FSTD certification under subsection 606.03(2) of the CARs or pursuant to a Minister approved Bilateral Aviation Safety Agreement between Canada and a foreign state.

1.3 Description of Changes

- 1.3.1 Transport Canada Publication (TP) 9685 Revision 3, is a complete reissue that replaces Revision 2. The document has been restructured to eliminate duplication, address new simulator technology and better harmonize with Federal Aviation Administration (FAA) and European Aviation Safety Agency (EASA) standards. The key changes include:
- The addition of policy to clarify a sponsor's eligibility and responsibilities when applying for FSTD evaluations and continuing qualification;
 - Alignment of Level 4 to 7 and Level A to D requirements with the qualification performance standards found in FAA Title 14 CFR Part 60; and
 - The introduction of new Level 1 to 2 FSTD standards that are tailored to support Transport Canada training requirements for Private Pilot License (PPL), Commercial Pilot License (CPL), IR and renewal, Multi Crew Coordination (MCC) training as approved by the Minister.

1.4 Reference Documents

- 1.4.1 It is intended that the following reference materials be used in conjunction with this document:
- Aeronautics Act;
 - Part IV, VI and VII of the Canadian Aviation Regulations (CARs);
 - Federal Aviation Administration (FAA) 14 CFR Part 60;
 - International Civil Aviation Organization (ICAO) Doc 9625 AN/938 Third Edition 2009 – *Manual of Criteria for Qualification of Flight Simulation Training Devices*, Volume I (Aeroplanes) and Volume II (Helicopters).

1.5 Definitions and Abbreviations

- 1.5.1 Definitions:

1st Segment — the portion of the takeoff profile from liftoff to gear retraction.

2nd Segment — the portion of the takeoff profile from after gear retraction to initial flap/slat retraction.

3rd Segment — the portion of the takeoff profile after flap/slat retraction is complete.

Aeroplane — a power-driven, heavier-than-air aircraft deriving its lift from aerodynamic reaction from surfaces that remain fixed under given flight conditions.

Aircraft — any machine capable of driving support in the atmosphere from reactions of the air. For the purposes of the document, the term includes both aeroplanes and rotorcrafts.

Aircraft Data Package — a combination of the various types of data used to design, program, manufacture, modify, and test the FSTD.

Airport Models —

Class I. Whether modeling real world or fictional airports (or landing areas for helicopters), these airport models (or landing areas for helicopters) are those that meet the requirements of Table A3B or C3B, found in attachment 2 of Appendix A or C, as appropriate, are evaluated by the NSPM, and are listed on the SOQ.

Class II. Whether modeling real world or fictional airports (or landing areas for helicopters), these airport models (or landing areas for helicopters) are those models that are in excess of those used for simulator qualification at a specified level. The FSTD sponsor is responsible for determining that these models meet the requirements set out in Table A3C or C3C, found in attachment 2 of Appendix A or C, as appropriate.

Class III. This is a special class of airport model (or landing area for helicopters), used for specific purposes, and includes models that may be incomplete or inaccurate when viewed without restriction, but when appropriate limits are applied (e.g., “valid for use only in visibility conditions less than 1/2 statute mile or RVR2400 feet,” “valid for use only for approaches to Runway 22L and 22R”), those features that may be incomplete or inaccurate may not be able to be recognized as such by the crewmember being trained, tested, or checked. Class III airport models used for training, testing, or checking activities under this Chapter requires the certificate holder to submit to the TPAA an appropriate analysis of the skills, knowledge, and abilities necessary for competent performance of the task(s) in which this particular model is to be used, and requires TPAA acceptance of each Class III model.

Airspeed — calibrated airspeed unless otherwise specified and expressed in terms of nautical miles per hour (knots).

Altitude — pressure altitude (meters or feet) unless specified otherwise.

Angle of Attack — the angle between the airplane longitudinal axis and the relative wind vector projected onto the airplane plane of symmetry.

Approved Training Program — means a flight crew member training program approved by the Minister pursuant to the Canadian Aviation Regulations.

Automatic Testing — FSTD testing where all stimuli are under computer control.

Bank — the airplane attitude with respect to or around the longitudinal axis, or roll angle (degrees).

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

Certificate Holder — a person issued a certificate under Canadian Aviation Regulation Part IV, VI or VII.

Class — in relation to the classification of aeroplanes, means aeroplanes having similar operating characteristics to single-engine aeroplanes, multi-engine aeroplanes, centre-line thrust aeroplanes, land aeroplanes or sea aeroplanes.

Closed Loop Testing — a test method where the input stimuli are generated by controllers that drive the FSTD to follow a pre-defined target response.

Cockpit — for synthetic flight training device purposes, consists of all that space forward of a cross-section of the fuselage at the most extreme aft setting of the pilot seats. Additional required crew member duty

stations and those required bulkheads aft of the pilot seats are also considered part of the cockpit and must replicate the aircraft.

Approved Check Pilot — means a pilot authorized to conduct Pilot Proficiency Check (PPC) rides on behalf of the Minister.

Component — means any material, part or sub-assembly intended for use on an aeronautical product.

Computer Controlled Aircraft — an aircraft where all pilot inputs to the control surfaces are transferred and augmented by computers.

Confined Area (helicopter operations) — an area where the flight of the helicopter is limited in some direction by terrain or the presence of natural or man-made obstructions (e.g., a clearing in the woods, a city street, or a road bordered by trees or power lines are regarded as confined areas).

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 neutral position.

Convertible FSTD — an FSTD in which hardware and software can be changed so that the FSTD becomes a replica of a different model, usually of the same type aircraft. The same FSTD platform, flight deck shell, motion system, visual system, computers, and peripheral equipment can be used in more than one simulation.

Critical Engine Parameter — the parameter that is the most accurate measure of propulsive force.

Dead band — 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.

Discrepancy — as used in this part, an aspect of the FSTD that is not correct with respect to the aircraft being simulated. This includes missing, malfunctioning, or inoperative components that are required to be present and operate correctly for training, evaluation, and experience functions to be creditable. It also includes errors in compliance processes or the documentation used to support the FSTD (e.g. MQTG errors, information missing from the MQTG, or required statements from appropriately qualified personnel).

Distance — the length of space between two points, expressed in terms of nautical miles unless otherwise specified.

Downgrade — a permanent change in the qualification level of an FSTD to a lower level.

Driven — a test method where the input stimulus or variable is positioned by automatic means, usually a computer input.

Electronic Copy of the MQTG — an electronic copy of the MQTG provided by an electronic scan presented in a format, acceptable to the NSPM.

Electronic Master Qualification Test Guide — an electronic version of the MQTG (eMQTG), where all objective data obtained from airplane testing, or another approved source, together with correlating objective test results obtained from the performance of the FSTD and a description of the equipment necessary to perform the evaluation for the initial and the recurrent evaluations is stored, archived, or presented in either reformatted or digitized electronic format.

End-to-End Testing — is the process in which control displacements are used as inputs.

Engine — as used in this part, the appliance or structure that supplies propulsive force for movement of the aircraft: i.e., the turbine engine for turbine powered aircraft; the turbine engine and propeller assembly for turbo-propeller powered aircraft; and the reciprocating engine and propeller assembly for reciprocating engine powered aircraft. For purposes of this part, engine failure is the failure of either the engine or propeller assembly to provide thrust higher than idle power thrust due to a failure of either the engine or the propeller assembly.

Evaluation —With respect to an FSTD, the qualification activities for the device (e.g., the objective and subjective tests, the inspections, or the recurrent evaluations) associated with the requirements of this manual.

Fictional Airport — a visual model of an airport that is a collection of “non-real world” terrain, instrument approach procedures, navigation aids, maps, and visual modeling detail sufficient to enable completion of an Airline Transport Pilot Certificate or Type Rating.

Flight Crew Member — means a pilot or flight engineer assigned to duties in an aircraft during flight time.

Flight Simulation Training Device (FSTD) — means an apparatus, including synthetic flight training equipment that replicates or emulates an aircraft or aircraft component for the purpose of pilot training and checking. The term refers to both a full flight simulator (FFS) and a flight training device (FTD).

Flight Test Data — (a subset of objective data) aircraft data collected by the aircraft manufacturer or other acceptable data supplier during an aircraft flight test program.

Flight Training Device (FTD) — a replica of aircraft instruments, equipment, panels, and controls in an open flight deck area or an enclosed aircraft flight deck replica. It includes the equipment and computer programs necessary to represent aircraft (or set of aircraft) operations in ground and flight conditions having the full range of capabilities of the systems installed in the device as described in the qualification performance standard (QPS) for a specific FTD qualification level.

Free Response — the response of the FSTD after completion of a control input or disturbance.

Frozen — a test condition where one or more variables are held constant with time.

FSTD Approval — the extent to which an FSTD may be used by a certificate holder as authorized by the FAA.

FSTD Directive — a document issued by the Transport Canada to an FSTD sponsor requiring a modification to the FSTD due to a safety-of-flight issue and amending the qualification basis for the FSTD.

FSTD Latency — the additional time for the FSTD to respond to input that is beyond the response time of the aircraft.

FSTD Performance — the overall performance of the FSTD, including aircraft performance (e.g., thrust/drag relationships, climb, range) and flight and ground handling.

Full Flight Simulator (FFS) — a replica of a specific type, make, model, or series aircraft. It includes the equipment and computer programs necessary to represent aircraft operations in ground and flight conditions, a visual system providing an out-of-the-flight deck view, a system that provides cues at least equivalent to those of a three-degree-of-freedom motion system, and has the full range of capabilities of the systems installed in the device as described the QPS for a specific FFS qualification level.

Functional Checks — means subjective checks carried out on an FSTD by a pilot qualified on the aircraft type supported by the device, to confirm that the FSTD handles like the aircraft to the extent that a pilot can accomplish all critical training and checking sequences and manoeuvres for which the device is intended to be credited.

Gate Clutter — the static and moving ground traffic (e.g., other airplanes; tugs; power or baggage carts; fueling, catering, or cargo trucks; pedestrians) presented to pose a potential conflict with the simulated aircraft during ground operations around the point where the simulated airplane is to be parked between flights

Generic Airport Model — a Class III visual model that combines correct navigation aids for a real world airport with a visual model that does not depict that same airport.

Grandfathering — as used in this manual, the practice of assigning a qualification basis for an FSTD based on the period of time during which a published set of standards governed the requirements for the initial and continuing qualification of FSTDs. Each FSTD manufactured during this specified period of time is “grandfathered” or held to the standards that were in effect during that time period. The grandfathered

standards remain applicable to each FSTD manufactured during the stated time period regardless of any subsequent modification to those standards and regardless of the sponsor, as long as the FSTD remains qualified or is maintained in a non-qualified status in accordance with the specific requirements and time periods prescribed in this manual.

Gross Weight — for objective test purposes:

Basic Operating Weight (BOW) — the empty weight of the aircraft plus the weight of the following: Normal oil quantity; lavatory servicing fluid; potable water; required crewmembers and their baggage; and emergency equipment.

Light Gross Weight — a weight chosen by the sponsor or data provider that is not more than 120% of the BOW of the aircraft being simulated or the minimum practical operating weight of the test aircraft.

Medium Gross Weight — a weight chosen by the sponsor or data provider that is within 10% of the average of the numerical values of the BOW and the maximum certificated gross weight.

Near Maximum Gross Weight — a weight chosen by the sponsor or data provider that is not less than the BOW of the aircraft being simulated plus 80% of the difference between the maximum certificated gross weight (either takeoff weight or landing weight, as appropriate for the test) and the BOW.

Ground Effect — the change in aerodynamic characteristics due to of the change in the airflow past the aircraft caused by the proximity of the earth's surface to the airplane.

Hands Off — a test maneuver conducted without pilot control inputs.

Hands On — a test maneuver conducted with pilot control inputs as required.

Heave — FSTD movement with respect to or along the vertical axis.

Height — the height above ground level (or AGL) expressed in meters or feet.

“In Use” Runway — as used in this part, the runway that is currently selected, able to be used for takeoffs and landings, and has the surface lighting and markings required by this part. Also known as the “active” runway.

Integrated Testing — testing of the FSTD so that all aircraft system models are active and contribute appropriately to the results. With integrated testing, none of the models used are substituted with models or other algorithms intended for testing only.

Irreversible Control System — a control system where movement of the control surface will not back-drive the pilot's control on the flight deck.

Latency — means the additional time beyond that of the basic aircraft perceivable response time due to the response of the simulator. This includes the update rate of the host computer added to the respective time delays of the motion system, visual system or instruments.

Line Oriented Flight Training (LOFT) — means a training and checking program approved by the Minister pursuant to the Canadian Aviation Regulations which uses an approved simulator capable of representing the air operator's route structure and which incorporates realistic pre-flight briefings, communications procedures and normal, abnormal and emergency procedures.

Locked — a test condition where one or more variables are held constant with time.

Management Representative — an employee of the sponsor delegated with the responsibility and authority to monitor the on-going qualification of assigned FSTDs and liaise with Transport Canada National Simulator Evaluation Program (NSEP) on the sponsor's behalf.

Manager, Simulator Program (MSP) — the Transport Canada manager responsible for the overall administration and direction of the NSEP or a person approved by that Transport Canada manager.

Manual Testing — FSTD testing conducted without computer inputs except for initial setup, and all modules of the simulation are active.

Master Qualification Test Guide (MQTG) — the Transport Canada-approved Qualification Test Guide with the addition of the Transport Canada-witnessed test results, applicable to each individual FSTD.

Medium — the normal operational weight for a given flight segment.

Minister — means the Minister of Transport.

Near Limiting Performance — the performance level the operating engine must be required to achieve to have sufficient power to land a helicopter after experiencing a single engine failure during takeoff of a multiengine helicopter. The operating engine must be required to operate within at least 5 percent of the maximum RPM or temperature limits of the gas turbine or power turbine, or operate within at least 5 percent of the maximum drive train torque limits. Near limiting performance is based on the existing combination of density altitude, temperature, and helicopter gross weight.

Nominal — the normal operating configuration, atmospheric conditions, and flight parameters for the specified flight segment.

Non-Normal Control — a term used in reference to Computer Controlled Aircraft. It is the state where one or more of the intended control, augmentation, or protection functions are not fully working. Note: Specific terms such as ALTERNATE, DIRECT, SECONDARY, or BACKUP may be used to define an actual level of degradation.

Normal Control — a term used in reference to Computer Controlled Aircraft. It is the state where the intended control, augmentation, and protection functions are fully working.

Objective Data — quantitative data, acceptable to the NSPM, used to evaluate the FSTD.

Objective Test — a quantitative measurement and evaluation of FSTD performance.

Operator — A certificate holder using an FSTD pursuant to CAR requirements.

Pitch — the airplane attitude with respect to, or around, the lateral axis expressed in degrees.

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

Predicted Data — estimations or extrapolations of existing flight test data or data from other simulation models using engineering analyses, engineering simulations, design data, or wind tunnel data.

Protection Functions — systems functions designed to protect an airplane from exceeding its flight maneuver limitations.

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

Qualification Level — the categorization of an FSTD established by the MSP based on the FSTDs demonstrated technical and operational capabilities as prescribed in this document.

Qualification Performance Standard (QPS) — the collection of procedures and criteria used when conducting objective and subjective tests, to establish FSTD qualification levels. The QPS are published in the appendices Chapters 4,5 and 6.

Qualification Test Guide (QTG) — the primary reference document used for evaluating an aircraft FSTD. It contains test results, statements of compliance and capability, validation data, the configuration of the aircraft simulated, and other information for the simulator evaluation specialist to assess the FSTD against the applicable regulatory criteria.

Quality Management System (QMS) — a flight simulation quality-systems that can be used for external quality-assurance purposes. It is designed to identify the processes needed, determine the sequence and interaction of the processes, determine criteria and methods required to ensure the effective operation and control of the processes, ensure the availability of information necessary to support the operation and monitoring of the processes, measure, monitor, and analyze the processes, and implement the actions necessary to achieve planned results.

Real-World Airport — as used in this part in reference to airport visual models, a computer generated visual depiction of an existing airport.

Representative — when used as an adjective in this part, typical, demonstrative, or characteristic of, the feature being described. For example, “representative sampling of tests” means a sub-set of the complete set of all tests such that the sample includes one or more of the tests in each of the major categories, the results of which provide the evaluator with an overall understanding of the performance and handling characteristics of the FSTD.

Reversible Control System — a control system in which movement of the control surface will back-drive the pilot's control on the flight deck.

Roll — the airplane attitude with respect to, or around, the longitudinal axis expressed in degrees.

Rotorcraft — means a power-driven, heavier-than-air aircraft supported in flight by the reaction of air on one or more rotors.

Set of Aircraft — a group or series of aircraft that share similar handling and operating characteristics, similar operating envelopes, and have the same number and type of engines or power-plants.

Sideslip Angle — the angle between the relative wind vector and the airplane plane of symmetry. (Note: this definition replaces the current definition of “sideslip.”)

Similar Type Aeroplane — means an aeroplane in the same propulsion category. The propulsion categories are turbo-jet, turbo-propeller or reciprocating.

Simulation Quality Management System (SQMS) — the elements of a quality management system for FSTD continuing qualification.

Simulator Evaluation Specialist — is a Transport Canada technical specialist, trained to evaluate simulators and to provide expertise on matters concerning aircraft simulation.

Small aircraft — means an aeroplane having a maximum permissible take-off weight of 5 700 kg (12,566 pounds) or less, or a helicopter having a maximum permissible take-off weight of 2 730 kg (6,018 pounds) or less.

Snapshot — means a presentation of one or more variables at a given instant of time. A snapshot is associated with a steady state condition in which the variables are essentially constant over time.

Special Evaluation — an evaluation of the FSTD for purposes other than initial, upgrade, or continuing qualification. Circumstances that may require a special evaluation include movement of the FSTD to a different location, or an update to FSTD software or hardware that might affect performance or flying qualities

Sponsor — a certificate holder under CAR Part IV, VI or VII, who seeks to operate an FSTD under CAR 606.03 and is responsible for requesting and maintaining an FSTD qualification in accordance with the requirements of and applicable Qualification Performance Standards (QPS) in this manual.

Statement of Compliance and Capability (SOC) — a declaration that a specific requirement has been met and explaining how the requirement was met (e.g., gear modeling approach, coefficient of friction sources). The SOC must also describe the capability of the FSTD to meet the requirement, including references to sources of information for showing compliance, rationale to explain how the referenced material is used, mathematical equations and parameter values used, and conclusions reached.

Step Input — an abrupt control input held at a constant value.

Subjective Test — a qualitative assessment of the performance and operation of the FSTD.

Surge — FSTD movement with respect to or along the longitudinal axis.

Sway — FSTD movement with respect to or along the lateral axis.

Synthetic Flight Training Device — Is the Canadian Aviation Regulation definition of an aircraft full flight simulator or a flight training device that meets the standards set out in this manual for the purpose of permitting

experience acquired therein to be credited towards meeting the requirements for a pilot proficiency check, the issue of a flight crew license, or the endorsement of a rating. [For the purposes of this document, the ICAO term “Flight Simulation Training Device” (FSTD) is used in lieu of Synthetic Flight Training Device].

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

T_i — Total time from initial throttle movement until a 10% response of a critical engine parameter.

T_f — Total time of the flare maneuver.

T_t — Total time from initial throttle movement to an increase of 90% of go around power or a decrease of 90% from maximum take-off power.

Training Program Approval Authority (TPAA) — For the purposes of this manual, the Training Program Approving Authority (TPAA) means the person in Transport Canada delegated by the Minister to approve a certificate holder’s pilot training and checking program, and authorize the use of a particular FSTD in that approved training program.

Training Restriction — a temporary condition where an FSTD with missing, malfunctioning, or inoperative (MMI) components may continue to be used at the qualification level indicated on its SOQ, but restricted from completing the tasks for which the correct function of the MMI component is required.

Transport Delay or “Throughput” — the total FSTD system processing time required for an input signal from a pilot primary flight control until motion system, visual system, or instrument response. It is the overall time delay incurred from signal input to output response. It does not include the characteristic delay of the airplane simulated.

Update — an improvement to or modernization of the quality or the accuracy of the FSTD without affecting the qualification level of the FSTD.

Upgrade — the improvement or enhancement of an FSTD for the purpose of achieving a higher qualification level.

Validation Data — objective data used to determine if the FSTD performance is within the tolerances prescribed in the QPS.

Validation Test — an objective test where FSTD parameters are compared to the relevant validation data to ensure that the FSTD performance is within the tolerances prescribed in the QPS.

Visual Data Base — a display that may include one or more airport models.

Visual System Response Time — the interval from a control input to the completion of the visual display scan of the first video field containing the resulting different information.

Yaw — the airplane attitude with respect to, or around, the vertical axis expressed in degrees.

1.5.2 Abbreviations

AFM	Airplane Flight Manual
AGL	Above Ground Level (meters or feet)
AOA	Angle of Attack (degrees)
APD	Aircrew Program Designee
CCA	Computer Controlled Aircraft
cd/m²	candela/meter ² , 3.4263 candela/m ² = 1 ft-Lambert
CFR	Code of Federal Regulations
cm(s)	centimeter, centimeters
daN	decaNewtons, one (1) decaNewton = 2.27 pounds
deg(s)	degree, degrees
DOF	Degrees-of-freedom
eMQTG	Electronic Master Qualification Test Guide
EPR	Engine Pressure Ratio
FAA	Federal Aviation Administration (U.S.)
FATO	Final Approach and Take Off area
fpm	feet per minute
ft	foot/feet, 1 foot = 0.304801 meters.
ft-Lambert	foot-Lambert, 1 ft-Lambert = 3.4263 candela/m ²
g	Acceleration due to Gravity (meters or feet/sec ²); 1g = 9.81 m/sec ² or 32.2 feet/sec ²
G/S	Glideslope
IATA	International Airline Transport Association
ICAO	International Civil Aviation Organization
IGE	In ground effect
ILS	Instrument Landing System
IOS	Instructor Operating Station
IQTG	International Qualification Test Guide
km	Kilometers; 1 km = 0.62137 Statute Miles
kPa	KiloPascal (Kilo Newton/Meters ²). 1 psi = 6.89476 kPa
kts	Knots calibrated airspeed unless otherwise specified, 1 knot = 0.5148 m/sec or 1.689 ft/sec
lb(s)	pound(s), one (1) pound = 0.44 decaNewton
LDP	Landing decision point
M,m	Meters, 1 Meter = 3.28083 feet
Min(s)	Minute, minutes
MLG	Main Landing Gear
Mpa	MegaPascals (1 psi = 6894.76 pascals)
MQTG	Master Qualification Test Guide
ms	millisecond(s)
MSP	Manager, National Simulator Evaluation Program Manager
N	NORMAL CONTROL Used in reference to Computer Controlled Aircraft
N1	Low Pressure Rotor revolutions per minute, expressed in percent of maximum
N2	High Pressure Rotor revolutions per minute, expressed in percent of maximum
N3	High Pressure Rotor revolutions per minute, expressed in percent of maximum
NAA	National Aviation Authority
nm	Nautical Mile(s) 1 Nautical Mile = 6,080 feet
NN	NON-NORMAL CONTROL Used in reference to Computer Controlled Aircraft
NWA	Nosewheel Angle (degrees)
OGE	Out of ground effect
PAPI	Precision Approach Path Indicator System
Pf	Impact or Feel Pressure, often expressed as “q”
PLA	Power Lever Angle.

PLF	Power for Level Flight
psi	pounds per square inch
QPS	Qualification Performance Standard
QTG	Qualification Test Guide
RAE	Royal Aerospace Establishment
R/C	Rate of Climb (meters/sec or feet/min)
R/D	Rate of Descent (meters/sec or feet/min)
REIL	Runway End Identifier Lights
RVR	Runway Visual Range (meters or feet)
s	second(s)
sec(s)	second, seconds
sm	Statute Mile(s) 1 Statute Mile = 5,280 feet
SMGCS	Surface Movement Guidance and Control System
SOC	Statement of Compliance and Capability
SOQ	Statement of Qualification
TC	Transport Canada
TIR	Type Inspection Report
TLOF	Touchdown and Loft Off area
T/O	Takeoff
VASI	Visual Approach Slope Indicator System
VGS	Visual Ground Segment
V1	Decision speed
V2	Takeoff safety speed
V_{mc}	Minimum Control Speed
V_{mca}	Minimum Control Speed in the air
V_{mcg}	Minimum Control Speed on the ground
V_{mcl}	Minimum Control Speed — Landing
V_{mu}	The speed at which the last main landing gear leaves the ground
VR	Rotate Speed
VS	Stall Speed or minimum speed in the stall
WAT	Weight, Altitude, Temperature

Chapter 2 - Policies and Procedures

2.1 Flight Simulation Training Device Use

- 2.1.1 Pursuant to section 606.03 of the *Canadian Aviation Regulations* (CARs), no person may use an Flight Simulation Training Device (FSTD) for pilot training or a pilot proficiency check required under Part IV, Part VI, or Part VII of the CARs unless the FSTD operator (sponsor) holds a FSTD certificate issued by the Minister. The Manager, Simulator Program (MSP) will issue a certificate on behalf of the Minister upon determining whether the FSTD:
- Satisfies the applicable qualification performance standard for the level of qualification requested; and
 - Has a single FSTD sponsor who is eligible under section [2.6](#) of this manual. The sponsor may arrange with another person for services of document preparation and presentation, as well as FSTD inspection, maintenance, repair, and servicing; however, the sponsor remains responsible for ensuring that these functions are conducted in a manner and with a result of continually meeting the requirements of this manual.
 - Remains qualified as described in the FSTD Qualification Certificate issued to the sponsor, through satisfactory inspection, recurrent evaluations, appropriate maintenance, and use in accordance with the applicable Qualification Performance Standards (QPS) and requirements in this manual.
 - Functions during day-to-day pilot training and checking activities with the software and hardware that was evaluated as satisfactory by the National Simulator Evaluation Program (NSEP) and, any modifications are implemented in accordance with the requirements at paragraph [2.16](#).
 - Is operated in accordance with the provisions and limitations of section [2.10](#).
- Note:** A person who knowingly makes any false representation for the purpose of obtaining a FSTD qualification certificate or any privilege accorded thereby; or makes or causes to be made any false entry in a record required under this manual with intent to mislead or wilfully omit to make any entry in any such record may be subject to action under Part 7.3 (1) of the Aeronautics Act.
- Once the Minister has issues an FSTD certificate to a sponsor, that FSTD is eligible for use by any Canadian Air Operator or Private Operator provided that they each receive approval from their Training Program Approval Authority (TPAA) to use the device in their respective approved training or checking program.

2.2 Manager of Simulator Program Responsibilities

- 2.2.1 The Manager of the MSP is the Minister's delegate responsible for assigning FSTD evaluations and issuing certificates required by section 606.03 of the CARs except in those cases where oversight of a non-type-specific FTD is delegated to Regional Authority (Chapter 6).
- 2.2.2 Before issuing an initial FSTD qualification certificate to the sponsor, the MSP or Regional Authority shall review the initial evaluation report to verify compliance and ensure the sponsor satisfies the eligibility criteria.
- 2.2.3 Unless it is otherwise deemed in the interest of the Minister, the MSP will only accept requests for evaluations if:
- The applicant or sponsor is eligible as per section [2.6](#); and
 - The FSTD is intended for use in a Transport Canada approved training program; or if it is used by an operator holding a Transport Canada Air Operator or Private Operator Certificate

in the course of conducting Pilot Proficiency Checks (PPC) or for the issuance of flight crew licences or a type rating endorsement.

- 2.2.4 The MSP may remove some or all of an FSTD qualification including the withdrawal of approval to use an FSTD in a Transport Canada approved training program; or deny an application for a qualification for reasons identified at section [2.11](#) of this Chapter.

2.3 Training Program Approval Authority Responsibilities

- 2.3.1 For the purposes of this manual, the Training Program Approving Authority (TPAA) means the person in Transport Canada delegated by the Minister to approve a certificate holder's pilot training and checking program, and who authorizes the use of a particular FSTD in that approved training program.

- 2.3.2 The TPAA is responsible for:

- a. Approving the use of a certified FSTD in the sponsor's Transport Canada approved training program;
- b. Determining whether a specific FSTD, or combination of FSTDs / aircraft are required to satisfy all elements in the sponsor's Transport Canada approved training program;
- c. Approving short term changes to an approved training program or session to accommodate an malfunctioning, or inoperative (MMI) declared under the provisions of section [2.10](#) .

Note: In accordance with paragraph [2.7.4](#), for each Canadian Air Operator or Private Operator using the FSTD, the sponsors must keep a copy of the TPAA's written approval to use the FSTD in their respective Transport Canada approved training program.

2.4 Evaluation Types

- 2.4.1 The National Simulator Evaluation Program conducts the following types of evaluations for the certification and continuing qualification of FSTDs pursuant to section 606.03 of the CARs. Application instructions and procedures for eligible sponsors and applicants are found at Chapter 3:

- a. **Initial Evaluation:** An evaluation for the purpose of determining the qualification level of an FSTD and assessing the sponsor's procedures and processes required to maintain compliance with this document.
- b. **Recurrent Evaluation:** A periodic evaluation of an FSTD to confirm the continuing qualification of the FSTD and compliance with sponsor requirements herein. This evaluation consists of objective tests, subjective tests, and verification that FSTD and sponsor continue to meet general requirements, as described in the applicable QPS as may be amended.

Note: The frequency of recurrent evaluations for Full Flight Simulators (FFS) and Flight Training Devices (FTD) are established by subsection 606.03 (5) of the CARs.

- c. **Foreign Evaluation:** An initial or recurrent evaluation of an FSTD located outside of Canada for an eligible applicant and FSTD sponsor.
- d. **Upgrade Evaluation:** An initial evaluation of a previously qualified FSTD for the purpose of raising its qualification level.
- e. **Update Evaluation:** A focused evaluation to verify the performance and functionality of a modification, improvement, or change to the FSTD that impacts the qualification performance as described in the MQTG, or changes the qualifications identified on the Qualification Certificate.

- f. **Special Evaluation:** An evaluation conducted at the discretion of the MSP to restore the qualification of an FSTD after a voluntary suspension, sponsor change, FSTD relocation, or qualification suspension / downgrade imposed due to unsatisfactory FSTD condition, performance or compliance to sponsor requirements. The scope of the evaluation will be determined by the MSP on a case-by-case basis.

2.5 Qualification Performance Standards

2.5.1 The Qualification Performance Standards (QPS) are a collection of procedures and criteria used when conducting objective and subjective tests, to evaluate and establish an FSTD qualification level. The QPS are published in appendices to this manual as follows:

- a. Chapter 4 - QPS for full flight simulators (FFS) -
 - 1) Appendix A - aeroplane FFS (Level A, B, C, D);
 - 2) Appendix B - rotorcraft FFS (Level B, C, D);
- b. Chapter 5 - QPS for type-specific flight training devices (FTD)-
 - 1) Appendix C - aeroplane FTD (Level 4, 5, 6, 7);
 - 2) Appendix D - rotorcraft FTD (level 4, 5, 6, 7); and
- c. Chapter 6 - QPS for non-type-specific flight training devices -
 - 1) Appendix E - aeroplane FTD (Level 1 and 2); and
 - 2) Appendix F - rotorcraft FTD (Level 1 and 2)

Note: Level 3 FTD QPS reserved for potential growth of non-type-specific FTD credits and therefore not published in this document.

2.5.2 **Initial Evaluations** - After the effective date of this manual, initial evaluations shall be conducted using the qualification performance standards of this manual except where the Minister has accepted:

- a. An earlier standard for previously qualified or relocated simulator that satisfies the conditions at paragraphs [2.5.3](#), [2.5.5](#), or [2.5.6](#); or
- b. An earlier standard for FTSDs located in a foreign state that is currently qualified by the foreign state authority and satisfies the conditions at paragraph [2.5.7](#).

2.5.3 **FSTDs Previously Qualified.** FSTDs with a valid Transport Canada NSEP qualification prior to the effective date of this manual will continue to be qualified based on the standard and criteria used when it was initially evaluated or last upgraded provided that:

- a. It continues to meet the standards, including the objective test results recorded in the MQTG and subjective tests, under which it was originally evaluated, regardless of sponsor;
- b. The sponsor complies with the other applicable provisions herein; and
- c. Any change in FSTD qualification level initiated is re-evaluated in accordance with the applicable QPS herein.

Note: For previously qualified FSTDs, the conditions for restoring a qualification that has been automatically lost or withdrawn are described at paragraph [2.13.2](#) .

2.5.4 **Request for Qualification Downgrade.** A sponsor may request that an FSTD be permanently downgraded. In such a case, the MSP may downgrade a qualified FSTD without requiring and without conducting an initial evaluation for the new qualification level. Subsequent recurrent evaluations will use the existing MQTG, modified as necessary to reflect the new qualification level. When the sponsor has appropriate validation data available and receives approval from the MSP, the sponsor may adopt tests and associated tolerances described in this manual as the basis for

continuing qualification of a previously qualified FSTD. The updated test(s) and tolerance(s) must be included as a permanent part of the MQTG.

- 2.5.5 **Sponsor change or FSTDs Relocated within Canada** – An FSTD relocated within Canada or undergoing a sponsorship change will require a special evaluation. The MSP will determine the scope of the evaluation on a case-by-case basis. The evaluation may be based on the standard used when the FSTD was first qualified or last upgraded provided that it was operating in compliance with that standard within one calendar year of the special evaluation to re-instate the qualification. FSTDs not meeting this condition or having undergone significant updates in conjunction with the relocation will be subject to an initial evaluation based on the standards and criteria herein.
- 2.5.6 **FSTDs Relocated to Canada** – FSTDs relocated to Canada from another country will require an initial evaluation. The MSP may accept the following qualification performance standards for initial evaluations of Level 4 to 7 and Level A to D FSTDs provided that the FSTD was operating in compliance with that standard within one calendar year of the initial evaluation. The sponsor must continue to comply with all other procedures and policies herein:
- FAA Title 14 CFR Part 60 as amended;
 - EASA CS-FSTD(A) as amended;
 - EASA CS-FSTD(H) as amended;
 - FAA AC 120-40C for simulators built before 01 January 2009;
 - JAR FSTD A for simulators built before 08 April 2012; or
 - JAR-STD 1A as amended for simulators built before 08 April 2012.
- 2.5.7 **Foreign Initial Evaluations** – In addition to the QPS in this manual, the MSP may accept the following standards for initial evaluations conducted on FSTDs located outside Canada provided that the simulator sponsor holds a current simulator qualification to that standard from EASA or the FAA. The sponsor must continue to comply with all other procedures and policies herein:
- FAA AC 120-40B for simulators built before 01 January 1998; or
 - FAA AC 120-40C for simulators built before 01 January 2009; or
 - JAR FSTD A for simulators built before 08 April 2012; or
 - JAR-STD 1A as amended for simulators built before 08 April 2012.
- ## 2.6 Sponsor Eligibility.
- 2.6.1 **Within Canada** A person is eligible to apply to be a sponsor of an FSTD located in Canada if the following conditions are met:
- The person holds, or is an applicant for, a Private Operator Certificate under *CAR Part VI*, an Air Operator Certificate under *CAR Part VII*, or a Flight Training Unit or Approved Training Organization (ATO) Certificate under *CAR Part IV*; and
 - The FSTD will be used, or will be offered for use, in the sponsor's Transport Canada approved flight training program for the aircraft being simulated as evidenced in a request for evaluation submitted to the NSEP.
- 2.6.2 **Outside of Canada** Application for initial or recurrent evaluations of FSTDs located outside Canada must originate from a Canadian Air Operator holding a certificate under *Part VII* of the CARs or a Canadian Private Operator holding a certificate under *Part VI of the CARs* provided that:
- The (foreign) FSTD sponsor holds a certificate under Title 14 of the Code of Federal Regulations (14 CFR) part 119, 141, or 142; or an EASA certificate for an Approved Training Organization (ATO), or a Type Rating Training Organization (TRTO); and

- b. The specific aircraft or set of aircraft simulated has a Transport Canada type-certificate authorizing their operation in Canada, and
- c. The TPAA approves the use of the FSTD in the applicant's Transport Canada approved training program; and
- d. The applicant signs an agreement for recovering the incremental costs of providing services outside of Canada (form 26-0622 (0710-03)).

Note: The MSP may accept the evaluation and qualification of an FSTD located in a foreign state if there is a Bilateral Aviation Safety Agreement and Simulator Implementation Plan between Canada and that foreign state. See Chapter 3, Section 3.9 for application procedures and requirements.

2.7 Additional Responsibilities of the Sponsor.

- 2.7.1 Upon request, the sponsor must allow the NSEP to inspect the FSTD as soon as practicable. This inspection may include all records and documents relating to the FSTD compliance with the requirements herein.
- 2.7.2 For each FSTD, the sponsor must post in or adjacent to the FSTD the Qualification Certificate issued by Transport Canada NSEP. An electronic copy of the Qualification Certificate that may be accessed via an appropriate terminal or display in or adjacent to the FSTD is satisfactory.
- 2.7.3 Each sponsor of an FSTD must identify to the MSP by name, one individual to be the management representative (MR).
 - a. One person may serve as an MR for more than one FSTD, but one FSTD must not be represented by more than one person serving in this capacity.
 - b. Each MR must be an employee of the sponsor with the responsibility and authority to monitor the on-going qualification of assigned FSTDs to ensure that all matters regarding FSTD qualification are being carried out in accordance with the provisions herein.;
 - c. The MR serves as the primary contact point for all matters between the sponsor and the NSEP regarding the qualification of that FSTD in accordance with the provisions herein.
- 2.7.4 Sponsors holding a Transport Canada NSEP Qualification Certificate for an FSTD located outside of Canada are responsible for ensuring that each Canadian Air Operator or Private Operator using the FSTD provides written approval from their TPAA. The sponsor must keep this approval on file and produce it to the MSP upon request.
- 2.7.5 For each Transport Canada qualified FFS and Level 4, 5, 6, and 7 FTD, the sponsor must obtain a written statement at least annually from a qualified pilot who has flown the aircraft or set of aircraft (as appropriate) during the preceding 12-month period stating that the subject FSTD's performance and handling qualities, within the normal operating envelope, represent the aircraft or set of aircraft described in the Transport Canada Type Certificate and the type data sheet, if appropriate. The sponsor must retain the two most current written statements for review by the MSP.
- 2.7.6 **Special equipment and personnel requirements for qualification of the FSTD.** When notified by the MSP, the sponsor must make available all special equipment and qualified personnel needed to accomplish or assist in the accomplishment of tests during initial qualification, continuing qualification, or special evaluations.
- 2.7.7 The sponsor is responsible for ensuring that recurrent evaluations are scheduled and confirmed with the NSEP no later than 60 days before the evaluation is due.

2.8 Compliance Processes

- 2.8.1 The sponsor must establish effective processes and auditable documentation to maintain continuing qualification of an FSTD in accordance with the applicable QPS, and to ensure compliance with sponsor requirements. Compliance processes will include procedures, methods and mechanisms to:
- a. Accomplish all appropriate objective tests each year as specified in the applicable QPS and ensuring the test results are reviewed by a qualified person.
 - b. Complete a functional pre-flight check on each FSTD within the preceding 24 hours.
 - c. Provide the MSP access to the objective test results in the MQTG and access to the FSTD for the length of time necessary for the MSP to complete the required recurrent evaluations.
 - d. Maintain a process for corrective and preventive maintenance on the FSTD to ensure that it continues to meet the requirements of the applicable QPS appendix. The process will be supported by a discrepancy log that ensures, when a discrepancy is discovered, the following requirements are met:
 - 1) A description of each discrepancy is entered in the log and remains in the log until the discrepancy is corrected.
 - 2) A description of the corrective action taken for each discrepancy, the identity of the individual taking the action, and the date that action is taken is entered in the log.
 - 3) The discrepancy log is kept in a form and manner acceptable to the Minister and is kept in or adjacent to the FSTD. An electronic log that may be accessed by an appropriate terminal or display in or adjacent to the FSTD is satisfactory.
 - e. Maintain revision control of the MQTG;
 - f. Maintain a current list of missing, malfunctioning or inoperative components in accordance with paragraph [2.10.2](#).
 - g. Notify the MSP in writing of intentions to modify the FSTD;
 - h. Notify the MSP when a modification has been completed and verified by a qualified pilot and technician to meet the functional, subjective and objective tests requirements of the applicable QPS;
 - i. Maintain records in plain language form or in coded form if the coded form provides for the preservation and retrieval of information in a manner acceptable to the MSP of:
 - 1) Results of the qualification evaluations (initial and each upgrade) since the issuance of the original Qualification Certificate, and
 - 2) Results of the objective tests conducted in accordance with paragraph [2.8.1 a](#) for a period of 2 years, and
 - 3) The MQTG and each amendment thereto, and
 - 4) A record of all FSTD modifications affected under paragraph [2.16](#) since the issuance of the original Qualification Certificate, and
 - 5) Results of the previous three recurrent evaluations, or the recurrent evaluations from the previous 2 years, whichever covers a longer period, and
 - 6) A complete record of all discrepancies entered in the discrepancy log over the previous 2 years.

Note: A person who knowingly makes any false representation for the purpose of obtaining a FSTD qualification certificate or any privilege accorded thereby; or makes or causes to be made any false entry in a record required under this manual with intent to mislead or wilfully omit to make any entry in any such record may be subject to action under Part 7.3 (1) of the Aeronautics Act.

2.9 FSTD Performance Degradation and Discrepancy Reporting

- 2.9.1 Logging FSTD discrepancies. Each instructor, or delegate of the Minister conducting pilot training or pilot proficiency checks pursuant to CAR requirements, and each person conducting the pre-flight inspection who discovers a discrepancy, including any missing, malfunctioning, or inoperative components in the FSTD, must write or cause to be written a description of that discrepancy into the discrepancy log at the end of the FSTD pre-flight or FSTD use session.
- 2.9.2 If the performance of an FSTD does not accurately simulate the flight characteristics of the aircraft or if special techniques not in common with the aeroplane are necessary to control the FSTD, the Inspector or Approved Check Pilot (ACP) is to terminate the check.
- If the FSTD is **located in Canada**, he/she will enter in the discrepancy log the statement “unsuitable for the conduct of a Pilot Proficiency Check (PPC)” along with sufficient substantiating details. If the FSTD can be returned to service without changes to its program, the signature of an Inspector qualified on type may authorize reinstatement of training and checking privileges. Should changes in the simulator programming be required, re-approval of the simulator will require authorization by the MSP.
 - If it is necessary to terminate or restrict a check utilizing a simulator **located outside of Canada**, he/she will inform the representative of the Canadian operator using the FSTD that it is not suitable for a PPC and notify the MSP. The entry in the discrepancy log **will not include** the statement “unsuitable for the conduct of a Pilot Proficiency Check (PPC)”.
- 2.9.3 If a simulator’s motion system, flight control system, or a system / component necessary for the FSTD occupants’ safety is inoperative or malfunctioning, the simulator must be declared “unsuitable for Pilot Training or Checking”. The MSP must be notified and appropriate entries must be made in the simulator discrepancy log.

2.10 Simulator Component Inoperative Guide and Operation with missing, malfunctioning, or inoperative components.

- 2.10.1 For the purposes of this document, a missing, malfunctioning, or inoperative (MMI) component pertains to any FSTD component, hardware / software appliance or function that is required to be present and correctly operate for the satisfactory completion of a maneuver, procedure, or task that is necessary to meet an element in an approved training or checking program.
- 2.10.2 The Sponsor is responsible for:
- Maintaining a current list of the MMI components that is readily available in or adjacent to the FSTD for review by users of the device. Electronic access to this list via an appropriate terminal or display in or adjacent to the FSTD is satisfactory. The discrepancy log may be used to satisfy this requirement provided each currently MMI component is clearly identified in the discrepancy log.
 - Each MMI component as described in paragraph [2.10.1](#), or any MMI component installed and required to operate correctly to meet the current Statement of Qualification, must be repaired or replaced within 30 calendar days, unless otherwise required or authorized by the MSP.
 - Notifying the MSP of any MMI that is not repaired within 30 days.
- 2.10.3 Pursuant to subsection 606.03 (4) of the CARs, no FSTD qualification certificate remains in force unless it maintains performance, and function in accordance with the applicable QPS, except in the cases set out in a Simulator Component Inoperative Guide (SCIG).
- 2.10.4 Each Air Operator Certificate holder, Private Operator Certificate holder, company organization or private citizen using the FSTD is responsible for developing a SCIG that reflects their operation and training program. Guidance for developing and using a SCIG is found at Attachment 2-1. The operator may decide that the use of a SCIG is not operationally beneficial due to the structure or

complexity of their training program. In the case where a SCIG is not used, training restrictions associated with the sponsor's current list of MMI components must be used as follows:

- a. The instructor, or delegate of the Minister on-site is responsible for assessing the impact of the MMI components on the training session and notify the TPAA of any short term adjustments to the training program.
- b. If the effect of the MMI component prevents reasonable adjustments to the approved training program or prevents the conduct of a pilot proficiency check, then the instructor, or delegate of the Minister will follow the procedures at section [2.9](#).

Note: In the absence of a SCIG, inoperative or malfunctioning **simulator** system such as visual system, motion system, flight control system, or a system or component necessary for the safety of the FSTD occupants is inoperative or malfunctioning, refer to paragraph [2.9.3](#). The suitability of the device for continued training with the malfunction will be determined by the MSP in consultation with the TPAA and sponsor.

2.11 Loss or partial loss of qualification.

2.11.1 **Qualification Removal:** The MSP may remove some or all of an FSTD qualification including the withdrawal of approval for use of an FSTD; or deny an application for a qualification if:

- a. The sponsor has provided an incorrect statement, upon which the Transport Canada NSEP relied or could have relied, made in support of an application for a qualification or a request for approval for use.
- b. The sponsor has provided an incorrect entry, upon which the Transport Canada NSEP relied or could have relied, made in any logbook, record, or report that is kept, made, or used to show compliance with any requirement for an FSTD qualification or an approval for use.
- c. A FFS at Level C or Level D does not have equipment and appliances installed and operating to the extent necessary for the issuance of a type-rating or the conduct of a Pilot Proficiency Check.
- d. A Level A or Level B FFS does not have equipment and appliances installed and operating to the extent necessary to support the simulator portion of training, testing and/or checking required for issuance of a type-rating or to the conduct of a Pilot Proficiency Check.
- e. The MSP has received notification from a Delegate of the Minister that action has been taken under section [2.9](#) to restrict the use of an FSTD due to a MMI component and the sponsor fails to correct the condition within 30 days.
- f. If a Delegate of the Minister, while conducting or monitoring training, informs the MSP that long term and/or multiple minor discrepancies on the FSTD are compromising the quality and effectiveness of the overall training.

2.11.2 **Immediate Suspension.** If the MSP determines that a circumstance exists which constitutes a threat to aviation safety, security, or the safe operation of the FSTD, the MSP will take the following immediate action:

- a. Withdraw some or all of the FSTD's qualifications to mitigate the threat, and make the withdrawal of qualification effective on the day the sponsor receives notice.
- b. In the notice to the sponsor, the MSP articulates the reasons for its finding that immediate action is required to mitigate a threat to aviation safety, security, or the safe operation of the FSTD, which makes it impracticable or contrary to the public interest to stay the effectiveness of the finding.

2.11.3 **Automatic Qualification Loss.** An FSTD qualification is automatically lost when any of the following occurs:

- a. The FSTD is not used to support a Transport Canada approved flight training program for the past 18 months.
- b. The FSTD is not inspected in accordance with subsection 606.03 (5) of the CARs.
- c. The FSTD is physically moved from one location and installed in a different location, regardless of distance.
- d. The MQTG is missing or otherwise not available and a replacement is not made within 30 days.

2.12 Notification of qualification loss.

2.12.1 Except as provided in paragraph [2.11.2](#), when the MSP determines that the FSTD no longer meets qualification standards, the following procedure applies:

- a. The MSP notifies the sponsor in writing that the FSTD no longer meets some or all of its qualification standards.
- b. The MSP sets a reasonable period (but not less than 7 days) within which the sponsor may submit written information, views, and arguments on the FSTD qualification.
- c. After considering all material presented, the MSP notifies the sponsor about the determination with regard to the qualification of the FSTD.
- d. When the MSP notifies the sponsor that some or all of the FSTD is no longer qualified, the action described in the notification becomes effective not less than 30 days after the sponsor receives that notice unless —
 - 1) The MSP finds under paragraph [2.11.2](#) of this section that immediate action is required to mitigate a threat to aviation safety or security or the safe operation of the FSTD, or that makes it impracticable or contrary to the public interest to delay the effectiveness of the finding. In such a case, the withdrawal of qualification is effective on the day the sponsor receives notification; or
 - 2) The sponsor appeals to the Director of Standards for reconsideration of the MSP finding under paragraph [2.12.2](#) of this section.

2.12.2 When a sponsor seeks reconsideration of a decision from the MSP concerning the FSTD qualification, the following procedure applies:

- a. The sponsor must appeal for reconsideration of that decision within 30 days of the date that the sponsor receives a notice that some or all of the FSTD is no longer qualified.
- b. The sponsor must address its appeal to the Director of Standards, Transport Canada.
- c. An appeal for reconsideration, if filed within the 30-day period, suspends the effectiveness of the determination by the MSP that the FSTD is no longer qualified unless the MSP has found, under paragraph [2.11.2](#) that immediate action is required.

2.13 Qualification restoration procedures

2.13.1 FSTD qualification lost under this section may be restored when one of the following provisions are met:

- a. The FSTD successfully passes an evaluation for initial qualification, where the MSP has determined that a full evaluation for initial qualification is necessary; or
- b. The FSTD successfully passes an evaluation for those elements of an initial qualification evaluation, as determined to be necessary by the MSP; or
- c. The MSP accepts a letter of compliance from the sponsor in lieu of an evaluation.

Note: In making the determinations described in section [2.13](#), the MSP considers factors including the reason for the loss of qualification, any repairs or replacements that may have to have been completed, the number of recurrent evaluations missed, the number of sponsor-conducted quarterly inspections missed, and the care that had been taken of the device since the loss of qualification.

- 2.13.2 If an FSTD qualification certificate issued based on a previous standard automatically loses its qualification under section [2.11](#), the following applies:
- a. Its qualification may be restored under paragraph [2.13.1](#) using the qualification basis (in terms of objective tests and subjective tests) against which the FSTD was originally evaluated and qualified provided that the re-qualification is conducted in less than (2) years
 - b. FSTD not restored under paragraph [2.13.1](#) for two (2) years or more, then the qualification basis (in terms of objective tests and subjective tests) for the re-qualification will be those standards in effect and current at the time of re-qualification application.

2.14 FSTD objective data requirements.

- 2.14.1 The validation data package, which consists of all objective data and other material or elements to support an initial evaluation and qualification of an FSTD, must be submitted in a form and manner acceptable to the MSP.
- 2.14.2 Evaluation of FSTD performance and handling qualities shall be based on a validation data package that includes aircraft manufacturer's flight test data and all relevant data developed after the type certificate was issued (e.g., data developed in response to an airworthiness directive) if such data results from a change in performance, handling qualities, functions, or other characteristics of the aircraft that must be considered for flight crewmember training, checking and currency pursuant to CAR requirements. The following exceptions apply:
- a. The validation data package may contain flight test data from a source in addition to or independent of the aircraft manufacturer's data in support of an FSTD qualification, provided that this data is gathered and developed by that source in accordance with flight test methods, including a flight test plan, as described in the applicable QPS.
 - b. The validation data package may also contain predicted data, engineering simulation data, data from pilot owner or pilot operating manuals, or data from public domain sources, provided this data is acceptable to the MSP. If found acceptable the data may then be used in particular applications for FSTD qualification.
 - c. Data requirements for non-type specific FTDs (Level 1, and 2) are addressed separately at Appendix E.
- 2.14.3 The MSP may require additional objective data, which may necessitate flight testing, if the validation data package does not support FSTD qualification requirements as described at paragraph [2.14.2](#) and the applicable QPS appendix.
- 2.14.4 The sponsor must notify the MSP when they learn, or are advised that the aircraft manufacturer or data provider has additional, amended or revised data that may relate to FSTD performance or handling characteristics.

2.15 Interim qualification of FSTDs for new aircraft types or models

- 2.15.1 A sponsor may apply for and the MSP may issue an interim qualification level for an FSTD for a new type or model of aircraft, even though the aircraft manufacturer's aircraft data package is preliminary, if the sponsor provides the following in accordance with the application requirements at Chapter 3, Section 3.6:

- a. The aircraft manufacturer's data, which consists of at least predicted data, validated by a limited set of flight test data;
- b. The aircraft manufacturer's description of the prediction methodology used to develop the predicted data; and
- c. The QTG test results.

2.15.2 An FSTD that has been issued interim qualification is deemed to have been issued initial qualification unless the MSP rescinds the qualification. The interim qualification terminates two years after it is issued, unless the MSP determines that specific conditions warrant otherwise.

2.15.3 Within twelve months of the release of the final aircraft data package by the aircraft manufacturer, but no later than two years after the issuance of the interim qualification status, the sponsor must apply for initial qualification in accordance with Chapter 3, Section 3.6 based on the final aircraft data package approved by the aircraft manufacturer, unless the MSP determines that specific conditions warrant otherwise.

2.15.4 An FSTD with interim qualification may be modified only in accordance with section [2.16](#) of this manual.

2.16 Modifications to FSTDs.

2.16.1 **Description of a modification.** For the purposes of this manual, an FSTD is said to have been modified when:

- a. Equipment or devices intended to simulate aircraft appliances are added to or removed from the FSTD, which change the MQTG or the Qualification Certificate issued by the Minister; or
- b. Changes are made to either software or hardware that are intended to impact flight or ground dynamics; changes are made that impact performance or handling characteristics of the FSTD (including motion, visual, control loading, or sound systems for those FSTD levels requiring sound tests and measurements); or changes are made to the MQTG.

Note: Routine software or hardware changes, or changes to the MQTG which do not affect required objective testing results or validation data approved during the initial evaluation of the FSTD are not considered modifications under this section.

2.16.2 **FSTD Directive.** An FSTD Directive may be issued if the Minister determines that an FSTD modification is necessary due to:

- a. Safety of flight reasons;
- b. An amendments to Part VI or Part VII of the CARs that affects training; or
- c. An airworthiness directive affecting the aircraft type, model or series number represented by the FSTD that affects training.

2.16.3 The sponsor of each affected FSTD must ensure that modifications are implemented according to the FSTD Directive regardless of the original qualification standards applicable to any specific FSTD.

2.16.4 **Using the modified FSTD.** The sponsor may not use, or allow the use of, or offer the use of, the FSTD with the proposed modification for pilot training or checking pursuant to CAR requirements until the approval process at Chapter 3, Section 3.4 of this manual is completed.

2.17 FSTD qualification based on a Bilateral Aviation Safety Agreement.

2.17.1 Bilateral agreements facilitate the reciprocal airworthiness certification of civil aeronautical products imported/exported between two signatory countries. A Bilateral Airworthiness Agreement (BAA) or Bilateral Aviation Safety Agreement (BASA) with Implementation Procedures for Airworthiness

(IPA) provides for airworthiness technical cooperation between the Transport Canada and its counterpart national aviation authorities (NAA). Simulator Implementation Procedure (SIP) sets out the technical and procedural terms for mutual cooperation, technical assistance, and acceptance of for each other's systems and standards for flight simulator qualification evaluations.

2.17.2 The MSP may issue a Transport Canada FSTD certificate to an eligible sponsor based on the evaluation and qualification of a contracting State to the Convention on International Civil Aviation for an FSTD located in that contracting State provided that:

- a. There is a BASA between Canada and the Contracting State that issued the original qualification; and
- b. There is a Simulator Implementation Procedure (SIP) established under the BASA; and
- c. The SIP contains any conditions and limitations on validation and issuance of such qualification by the TC.

Attachment 2-1 – Simulator Component Inoperative Guide

Purpose

The Canadian Aviation Regulations (CARs) state that each aircraft simulator in an approved training and checking program shall maintain the performance, functional and other characteristics required for approval. This means that each simulator must operate with all components operational at all times. If at any time its performance is degraded for any reason, the approval is void and any training or checking completed on the simulator while it is in this condition is invalid.

Some training and checking could be completed with certain components inoperative if relief were provided to the simulator approval requirements. While the aircraft Minimum Equipment List (MEL) is an important tool in training, especially in Line Oriented Flight Training (LOFT), it is not a practical relief vehicle. It relates directly to flight safety and airworthiness issues while the real issue is quality of training and not, strictly speaking, flight safety. Therefore, the MEL is not to be used to determine simulator training or checking status and another method of providing relief is required. Relief from the initial simulator approval requirements is permitted through the use of a Simulator Component Inoperative Guide (SCIG) or by following malfunctioning, or inoperative (MMI) procedures at Section 2.10 of Chapter 2.

Though the SCIG is concerned mainly with relief for full flight simulators, a SCIG can be prepared, approved and used with a training device. Typically a SCIG will focus on relief associated with simulator system malfunctions (i.e. visual, motion, controls, IOS etc.) however a SCIG may be drafted as comprehensively as the operator deems appropriate. MMI procedures at Section 2.10 of Chapter 2 provide a more flexible approach for air operators when dealing with systems of complex aircraft systems, or when using simulators from third party training providers.

Application for Use of the SCIG

The individual operator (the Air Operator Certificate holder, company organization or private citizen using the simulator), is responsible for a SCIG that reflects their operation/training program. For example, one operator may train and check to Category II/III limits while another may train and check only to Category I limits; therefore, the second operator could use relief from Category II/III related to an inoperative component. It also may be possible to permit the use of FFS as a fixed based FTD if the visual or motion system is inoperative.

Once the operator has prepared a SCIG, using the example in this Attachment as a guide, it shall be submitted to the MSP for approval. The MSP will review it for compliance with this manual and forward it to the operational authority for approval.

When approval is obtained, the SCIG will become part of the operator's training program. The SCIG must be readily available for review for each simulator training or checking session.

Procedures for Using the SCIG

Any component or subpart of a simulator that is intentionally made inoperative for the purpose of training or checking by inserting a malfunction on the instructor's console is not considered inoperative for the purpose of the SCIG.

Each component that becomes inoperative shall be recorded in the maintenance log book for that simulator and its impact on the approved status of the device is to be determined using the SCIG if the FSTD is to continue training. Any system or subpart that is not listed in the guide shall be operational at all times when training for credits or checking is being conducted. All components and systems are required to operate for all checking, except as noted under "Remarks" in Table 2-1.

Inoperative components will be documented and treated as an MMI and must be repaired within 30 days.

When a component becomes inoperative and the "Situation" column in Table 2-1 states "no training or checking", this means that the training credits and checking authorized for that phase of simulator are not allowed until the component is repaired.

SCIG Description

An example SCIG is contained in Table 2-1. This is an example for an aeroplane simulator; however, the same format and related content can be used for rotorcraft simulators and FTDs.

Table 2-1 lists the major simulator components, the operational condition of the component, the phase of simulator the component applies to, the category the simulator is placed in because of the component's condition and prescribes the action that is required for training or checking, if authorized.

When a component becomes inoperative the simulator will be placed in one of the following categories:

- no training or checking;
- training under specific conditions; or
- checking

An explanation of the column headings from Table 2-1 is as follows:

- **Component** - a principal essential part such as the radios, performance instruments, engine instruments, system control panels, motion system, visual system or control loading that is computer operated, including the computer.
- **Situation** - indicates which component or subpart has failed or deteriorated below initial qualification standards.
- **Level** - refers to the approved level of the simulator only and indicates to which level of simulator the inoperative component applies.
- **Categories** - are restrictions or authorizations placed on the simulator when a component becomes inoperative.
- **Remarks** - contains the conditions that must be met for training in specific conditions or when checking is authorized.

The following definitions are applicable to Table 2-1:

- **No Training or Checking** - means that the training credits and checking that were authorized in that level of simulator are not allowed with the component inoperative.
- **Training in Specific Conditions** - means some training is permitted if certain conditions are met as stated under the "Remarks" column in Table 2-1.
- **Checking** - means any checking for a flight crew member licence, rating, type rating, LOFT, regency of experience, night take-off and landings and proficiency checks.

Table 2-1 – Example of Simulator Component Inoperative Guide

Table 2-1 – Example of Simulator Component Inoperative Guide				
Component	Situation	Level	Categories	Remarks
Visual Optical System	Captain Forward screen Inoperative	A,B,C,D	Training under Specific Conditions*	First Officer (only). Instructor may occupy captain or instructor seat. Another pilot may occupy captain's seat but receives no credit.
	**Captain Side screen Inoperative	C,D	Training under Specific Conditions*	** If Level C or D training program: First Officer (only). Instructor may occupy captain or instructor seat. Another pilot may occupy captain's seat but receives no credit. **If Level A or B training program: No left circling procedures.
	***Captain Side screen Inoperative	A,B	Training under Specific Conditions*	*** If fitted. No left circling procedures. * All checking authorized except for left circling procedures.
	First Officer Forward screen Inoperative	A,B,C,D	Training under Specific Conditions*	Captain (only). Instructor may occupy First Officer or instructor seat. Another pilot may occupy First Officer's seat but receives no credit.
	**First Officer Side screen Inoperative	C,D	Training under Specific Conditions	** If Level C or D training program: Captain and Flight Engineer Training (only). Instructor may occupy First Officer or instructor seat. Another pilot may occupy First Officer's seat but receives no credit. **If Level A or B training program: No right circling procedures.
	***First Officer Side screen Inoperative	A,B	Training under Specific Conditions*	*** If fitted. No right circling procedures. * All checking authorized except for right circling procedures.
	Daylight scene not available	D	Training under Specific Conditions	All training and checking using dusk, dawn and/or night scenes permitted.
Motion System	Inoperative	A,B,C,D	No Training or Checking	
Control Loading System	Inoperative	A,B,C,D	No Training or Checking	N/A
Sound Audio System	Inoperative	A,B,C,D	Training under Specific Conditions	Must be operational and at the volume level as initially approved for all training and checking; however , an instructor may turn the sound completely off for short durations to instruct or explain procedures.
Console at Instructor Station	Inoperative	A,B,C,D	Training under Specific Conditions	May be inoperative if a portable remote control unit is available and operational. The instructor may use the unit from any seat location.
Lights and Annunciator including Master Warning	Inoperative	A,B,C,D	Training under Specific Conditions	Malfunction Illuminated. One annunciator light on each system may be inoperative provided the same information can be obtained from another source. Example: Oil pressure warning light inoperative, oil pressure instrument gauge could be used. Normal Operation Illuminated. Lights may be inoperative provided required information can be obtained from another source. Example: Pilot heat normal operation light is inoperative. Information could be obtained from ammeter.
Light Annunciator Including Master Warning	Inoperative	A,B,C,D	Training under Specific Conditions	Master Warning. At least one must operate.
Lights Cockpit Controlled	Inoperative	A,B,C,D	Training under Specific Conditions	Any one or group of lights may be inoperative provided lighting is available from another source. Example: The captain's instrument lights are inoperative. The panel fluorescent lights could be used.

Table 2-1 – Example of Simulator Component Inoperative Guide				
Component	Situation	Level	Categories	Remarks
Instrument Flight	One or All are Inoperative	A,B,C,D	Training under Specific Conditions	All instruments required by Regulations for the type operation/training to be conducted must operate at the pilot seat where training credit is allowed. Example: Day, night, IFR, VFR. One or all may be inoperative at the other pilot seat. The instructor or another pilot may occupy that seat and no training credit will be allowed.
Instruments Performance	Inoperative	A,B,C,D	Training under Specific Conditions	One per engine may be inoperative. Example: N2 gauge is inoperative. N1, N3, EPR must operate. EGT gauge is required for all training. Torque meter is required for all training. Torque meter is required for all training in turboprop aeroplane simulators.
Instruments Navigation	Inoperative	A,B,C,D	Training under Specific Conditions*	Only those navigation instruments required for the navigation or instrument approach training to be conducted must operate. Example: Conducting NDB approaches, VOR and ILS could be inoperative.
Instruments Quantity	Inoperative	A,B,C,D	Training under Specific Conditions	One from each system may be inoperative provided the information can be obtained from another source. Example: One fuel tank quantity gauge is inoperative. In the case of quantity , the instructor may provide that information from the instructor's console.
Instruments System Operation	Inoperative	A,B,C,D	Training under Specific Conditions	One may be inoperative from each system provided system operation can be confirmed from another source. Example: Hydraulic system pressure gauge is inoperative; however, the pressure light operates.
Computer	Inoperative	A,B,C,D	No Training or Checking	N/A
Cockpit to Computer Input-Output System (Signal Conversion)	Inoperative	A,B,C,D	No Training or Checking	N/A

Chapter 3 - Sponsor Administrative Procedures - Applications and Notifications

3.1 General

- 3.1.1 The sponsor will initiate applications by sending a “letter of intent” to the Manager, Simulator Program (MSP) or Regional Authority. A letter of intent is required for:
- All Flight Simulation Training Device (FSTD) initial, upgrade, and foreign evaluations,
 - A change of FSTD sponsor,
 - FSTD relocation, and
 - Notifications of modifications that may require an update or special evaluation.
- 3.1.2 Prior to an evaluation scheduled in response to a letter of intent, the sponsor’s management representative must provide a signed “letter of compliance” to confirm they have verified that the FSTD is ready for an evaluation. The letters will be submitted as per the processes and requirements in this Chapter.
- 3.1.3 The subjective tests and objective tests that form the basis for a letter of compliance must be accomplished at the sponsor's training facility or other sponsor designated location where training will take place, except as provided for in the applicable QPS.
- 3.1.4 The pilot(s) contributing to a letter of compliance must:
- Be designated by the sponsor; and
 - Be qualified in;
 - The aircraft or set of aircraft being simulated, or
 - For aircraft not yet issued a type certificate, or aircraft not previously operated by the sponsor or not having previous Transport Canada-approved training programs conducted by the sponsor, an aircraft similar in size and configuration.
- 3.1.5 An FSTD sponsor or FSTD manufacturer may submit a request to the Minister for approval of a deviation from the QPS requirements as defined in this manual.
- Requests for deviation must be submitted in a form and manner acceptable to the Minister and must provide an alternate means of compliance that meets or exceeds the testing requirements and tolerances as specified in the applicable QPS or will otherwise not adversely affect the fidelity and capability of the FSTDs evaluated and qualified under the deviation.
 - The Minister may consider deviation from the minimum requirements tables, the objective testing tables, the functions and subjective testing tables, and other supporting tables and requirements in the applicable QPS.
 - Deviations may be issued to an FSTD manufacturer for the initial qualification of multiple FSTDs, subject to terms and limitations as determined by Minister. Approved deviations will become a part of the permanent qualification basis of the individual FSTD and will be noted in the FSTD's Statement of Qualification.

3.2 Acceptance of Validation Data

- 3.2.1 Except in the case of interim qualifications, flight test data sources supplied by the aircraft manufacturer or validation data used on FSTD of the same aircraft type previously qualified by Transport Canada NSEP, FAA NSP or EASA will be reviewed and accepted as part of the initial qualification evaluation in accordance with the applicable QPS.

- 3.2.2 **Independent data providers.** The MSP must review and accept validation data packages generated from a source independent of aircraft manufacturer's data before it is used in support of an FSTD qualification. The review will verify that this data is gathered and developed by that source in accordance with flight test methods, including a flight test plan, as described in the applicable QPS.

3.3 Application for Initial or Upgrade Evaluations.

- 3.3.1 The sponsor seeking to qualify an FSTD must provide the MSP access to the FSTD for the length of time necessary for the NSEP to complete the required evaluation of the FSTD for initial qualification, which includes the conduct and evaluation of objective and subjective tests, including general FSTD requirements, as described in the applicable QPS, to determine that the FSTD meets the standards in that QPS.

- 3.3.2 **Reinstating a Qualification.** Sponsors requesting an initial evaluation to re-instate an FSTD qualification that was lost due to a voluntary suspension, relocation, or sponsor change will follow the application procedures for an initial evaluation in this section:

- a. The MSP may decide to conduct a **special evaluation** in lieu of an initial evaluation if a reduced-scope evaluation is deemed sufficient to re-instate the qualification. The MSP will be determine the scope and focus of each special evaluation on a case-by-case basis.
- b. If a qualification has been removed under paragraph [2.11.1](#) or immediately suspended under paragraph [2.11.2](#), the MSP will follow the procedures at section [2.13](#) to restore the qualification.

- 3.3.3 **Application process.** The application process for an initial, upgrade, or interim qualification evaluation will be administered according to the following steps:

- a. **Letter of Intent.** For each FSTD, the sponsor must submit a "letter of intent" requesting an initial qualification evaluation to the MSP through the appropriate regional or national office no later than 120 days prior to the evaluation date requested.) The letter will include A description of the FSTD;
 - 1) The anticipated qualification level of the FSTD;
 - 2) The make, model, and series of aircraft simulated; and any other pertinent information.
 - 3) Request for approval to use an earlier standard as may be permitted in paragraph [2.5.2](#);
 - 4) Any requests for deviations from the standard and/or alternate means of compliance to specific requirements set out in the applicable QPS; and
 - 5) Any additional information that may affect the scope of the evaluation (i.e. FSTD relocation, sponsorship change, restoration after voluntary suspension etc.)

Note: Requirements at sections [3.2](#) or [3.6](#) may be applicable if the sponsor intends to use validation data from sources independent of the aircraft manufacturer, or request an interim qualification for a new aircraft, To avoid any qualification delays, the sponsor should contact the MSP as early as possible to coordinate a review and acceptance of the validation data package.

Note: For Non-Type Specific FTDs "letters of intent" refer to Chapter 6.

- b. **NSEP response.** The MSP or delegated regional office will reply to the letter of intent within 15 business days with the following information;
 - 1) Tentative dates for the initial evaluation;
 - 2) The date the sponsor must submit the QTG if applicable;
 - 3) A response to sponsor requests to; use an earlier standard, deviate from the applicable QPS, or use an alternate means of compliance; and

- 4) An attached “qualification profile” form to be completed and returned to the MSP with or before the QTG submission.
- 5) Any special equipment and qualified personnel needed to accomplish or assist in the accomplishment of tests during initial qualification.
- c. **QTG Review.** The Sponsor will submit the QTG (including validation data) in the form and manner described in the applicable QPS. The MSP will review the QTG and forward comments and questions resulting from the review to the Sponsor for their response. Depending on the results of the review, the MSP will confirm or postpone the evaluation date. The sponsor will provide a response to the QTG review comments no later than 5 working days before the evaluation date.
- d. **Letter of Compliance.** The Sponsor will submit a “letter of compliance” signed by the management representative no later than 5 working days before the evaluation confirming that:
 - 1) Qualified pilot(s), meeting the requirements of paragraph 3.1.4, after having flown all of the Operations Tasks listed in the applicable QPS appendix relevant to the qualification level of the FSTD, have determined that the performance and handling qualities of the FSTD represent those of the aircraft or set of aircraft within the normal operating envelope. Exceptions, if any, must be noted. The name of the pilot(s) making this determination must be identified on the letter of compliance. Exceptions, if any, must be noted.
 - 2) Qualified pilot(s), meeting the requirements of paragraph 3.1.4, or person(s) trained on simulator systems/sub-systems and trained on the operation of the simulated aircraft systems, after having exercised the operation of the FSTD and the pertinent functions available through the Instructor Operating Station(s) have determined that: FSTD systems and sub-systems (including the simulated aircraft systems) functionally represent those in the aircraft or set of aircraft; and the cockpit represents the configuration of the specific type or aircraft make, model, and series aircraft being simulated, as appropriate. The name of the person(s) making this determination must be available to the MSP upon request. Exceptions, if any, must be noted.

3.3.4 When the FSTD passes an evaluation for initial qualification, the MSP issues a Qualification Certificate that includes all of the following:

- a. A Transport Canada Identification number (TCID);
- b. Identification of the sponsor;
- c. Identification of the make, model, and series of the aircraft or set of aircraft being simulated;
- d. Identification of the configuration of the aircraft or set of aircraft being simulated (e.g., engine model or models, flight instruments, or navigation or other systems);
- e. A statement that the FSTD is qualified as either a full flight simulator or a flight training device;
- f. Identification of the qualification level of the FSTD;
- g. A statement that (with the exception of the noted exclusions for which the FSTD has not been subjectively tested by the sponsor or the MSP and for which qualification is not sought) the qualification of the FSTD includes the tasks set out in the applicable QPS appendix relevant to the qualification level of the FSTD; and

Note: Examples of the exclusions for which the FFS might not have been subjectively tested by the sponsor or the MSP and for which qualification might not be sought or granted include wind-shear training; circling approaches; upset training etc.

- h. A statement referencing any deviations that have been granted and included in the permanent qualification basis of the FSTD.

- 3.3.5 After the NESP completes the evaluation for initial qualification, the sponsor must update the Qualification Test Guide (QTG), with the results of the Transport Canada-witnessed tests together with the results of all the objective tests described in the applicable QPS.
- 3.3.6 Upon issuance of the Qualification Certificate the updated QTG becomes the Master Qualification Test Guide (MQTG). The MQTG must be made available to the MSP upon request.

3.4 Notification of FSTD Modifications and updates.

- 3.4.1 The sponsor must notify the MSP in writing at least 21 days prior to making a modification to an FSTD described in paragraph [2.16.1](#) of this manual. If the modification removes, increases, or changes the training qualifications identified on the Qualification Certificate, the sponsor must also notifying the TPAA of each Canadian air operator or private operator using the FSTD.
- 3.4.2 **MQTG updates.** The sponsor must update the MQTG with current objective test results and appropriate objective data each time an FSTD is modified and an objective test or other MQTG section is affected by the modification. If an FSTD Directive is the cause of this update, the direction to make the modification and the record of the modification completion must be filed in the MQTG.
- 3.4.3 **Notification and approval process.** The notification and approval process for an update or modification is as follows:
- a. **Letter of Intent.** For each FSTD, the sponsor will submit a “letter of intent” to the MSP that:
 - 1) Provides a description of the modification or update;
 - 2) Identifies any procedural, functional or physical change to the FSTD that may affect pilot training and checking;
 - 3) Identifies impact flight or ground dynamics; changes are made that impact performance or handling characteristics of the FSTD;
 - 4) Identifies any required changes to the MQTG; and
 - 5) Provides a date when the modification or update would be available for evaluation.
 - b. **NSEP response.** The MSP or delegated regional office will reply to the letter of intent within 5 business days with the following:
 - 1) Whether an update evaluation is required,
 - 2) Tentative date and scope of the update evaluation if required,
 - 3) Any special equipment and qualified personnel needed to accomplish or assist in the accomplishment of tests during the update evaluation, and
 - 4) Any additional requirements for approval if an update evaluation is deemed unnecessary.
- Note:** Depending on the complexity and impact on training, the MSP may approve a modification based on a letter of compliance from the sponsor.
- c. **Letter of Compliance.** The Sponsor will submit a “letter of compliance” signed by the management representative no later than 5 working days before a modification is implemented or evaluated confirming that:
 - 1) Qualified pilot(s), meeting the requirements of paragraph [3.1.4](#), after having flown the relevant Operations Tasks and determined that the modification or update represent those of the aircraft or set of aircraft within the normal operating envelope. Exceptions, if any, must be noted. The name of the pilot(s) making this determination must be identified on the letter of compliance.
 - 2) Qualified pilot(s), meeting the requirements of paragraph [3.1.4](#), or person(s) trained on simulator systems/sub-systems and trained on the operation of the simulated aircraft systems, after having exercised the operation of the FSTD and the pertinent functions

available through the Instructor Operating Station(s) have determined that: FSTD modification or update functionally represents those in the aircraft or set of aircraft; and all affected QTG tests are in tolerance. The name of the person(s) making this determination must be available to the MSP upon request. Exceptions, if any, must be noted.

- d. **Approval.** The MSP will approve the use of a modification when:
- 1) The FSTD successfully passes a special evaluation according to the scope defined by the MSP in the response to the letter of intent; or
 - 2) The MSP has notified the sponsor that the letter of compliance has been accepted in lieu of an evaluation.; and
 - 3) The Qualification Certificate has been appropriately amended.

3.5 Application for Foreign Evaluations

3.5.1 Unless otherwise deemed in the interest of the Minister, the MSP will only accept requests for foreign evaluations if the eligibility requirements at paragraph [2.6.2](#) of this manual are satisfied.

3.5.2 **Application process.** The application process for a foreign initial evaluation is as follows:

- a. **Letter of Intent.** Applicants requesting an initial qualification evaluation of an FSTD located outside of Canada must submit a “letter of intent” to the MSP and the applicant’s TPAA no later than 120 days prior to the evaluation date requested. The letter will include:
- 1) A description of the FSTD to include - manufacturer, current qualification level, the make / model and series of aircraft simulated;
 - 2) Information to justify the need for the FSTD in the applicant’s approved training program and the date the applicant wishes to begin training;
 - 3) the foreign sponsor’s name (FSTD operator), address, and contact information of the management representative;
 - 4) A copy of the National Authority’s latest qualification Certificate and evaluation report;
 - 5) A statement that the applicant has read and understood the eligibility requirements at paragraph [2.6.2](#) ; and
 - 6) Contact information for the applicant and their Transport Canada TPAA.
- b. **NSEP response.** After reviewing the applicant’s request with their TPAA and the foreign sponsor, the MSP will reply to the letter of intent with the following;
- 1) Whether the request for a foreign evaluation is accepted;
 - 2) Tentative dates for the initial evaluation;
 - 3) The date the foreign sponsor must submit the QTG if applicable;
 - 4) Any qualified personnel and/or support from the applicant and sponsor needed to coordinate or complete the initial qualification.

Note: The applicant is responsible for coordinating acceptable dates and FSTD slots (between 0800 and 1630 local time) with the FSTD sponsor and the NSEP. The dates of the evaluation are contingent upon the FSTD sponsor’s scheduling constraints and ability to support scope of evaluation required by the MSP.

- c. **Cost-recovery contract.** Before the MSP commits any resources to the evaluation, the applicant must sign an agreement for recovering the incremental costs of providing services outside of Canada (form 26-0622 (0710-03), and provide a cost estimate to the applicant if requested.

- d. **Evaluation Plan.** The MSP will inform foreign sponsor of the scope of the evaluation, and coordinate a test plan to verify QPS requirements. All correspondence with the sponsor will be copied to the applicant.
- e. **On-Site Evaluation.** Upon successful completion of the evaluation, the MSP will issue the sponsor a qualification certificate and copy the applicant and their TPAA. Before leaving the facility, the evaluator will brief the sponsor on the administrative procedures and responsibilities to maintain the FSTD's continuing qualification in accordance with this manual.
- f. **Recurrent evaluations.** Before planning an evaluation for continuing qualification, the MSP will verify that the applicant has used the FSTD during the past 12 months and receive written confirmation from the applicant that they wish to continue the agreement for recovering the incremental costs of providing services outside of Canada.

Note: In accordance with paragraph [2.7.4](#), for each Canadian Air Operator or Private Operator using the FSTD, the sponsors must keep a file copy of the TPAA's written approval to use the FSTD in their respective TC approved training program.

3.6 Application for Interim Qualification.

- 3.6.1 Sponsors applying for an FSTD interim-qualification evaluation of and aeroplane or rotorcraft FSTD will follow the procedures for an initial evaluation at section [3.3](#). The letter of intent will include the sponsor's plan and timelines regarding the review and acceptance of the proposed validation data package and engineering reports required for the interim qualification.
- 3.6.2 The MSP must review and accept predicted validation data proposed by an aircraft manufacturer before it is used to support an FSTD interim-qualification for a new aircraft type. Simulator sponsors seeking qualification based on preliminary data should consult the MSP to make special arrangements for its use in the FSTD qualification. The precise procedure used to accept the validation data will vary from case to case and between aircraft manufacturers. The MSP, in consultation with the aircraft manufacturer, will adapt the process to accommodate the new aircraft development and test programme.
- 3.6.3 The sponsor should also consult the airplane and flight simulator manufacturers to develop a data plan and flight simulator qualification plan. The MSP's acceptance of the interim-qualification data package will reference the following documents provided by the FSTD sponsor:
 - a. A "Validation Road Map (VDR)" that identifies the combination of predicted and flight test data sources proposed by the aircraft manufacturer with the assurance that the data will best represent the aircraft with reasonable certainty that final data will not deviate to a large degree from these preliminary, but refined, estimates. The VDR should clearly identify sources of data for all required tests, a description of the validity of these data for a specific engine type and thrust rating configuration, and the revision levels of all avionics affecting the performance or flying qualities of the aircraft. It should also provide other information, such as the rationale or explanation for cases where data or data parameters are missing, instances where engineering simulation data are used or where flight test methods require further explanations. It should also provide a brief narrative describing the cause and effect of any deviation from data requirements. The aircraft manufacturer may provide this document.
 - b. A NSEP Audit of the aircraft manufacturer's engineering simulation or the engineering simulator used to generate the validation data to verify the requirements in the applicable QPS.
- 3.6.4 The Minister may approve the use of a validation data package for an interim qualification if it has been reviewed and accepted by a foreign state where a Bilateral Aviation Safety Agreement and Simulator Implementation Plan exists between Canada and that foreign state.
- 3.6.5 The preliminary data should be the manufacturer's best representation of the airplane, with assurance that the final data will not significantly deviate from the preliminary estimates. Data

derived from these predictive or preliminary techniques should be validated against available sources including, at least, the following:

- a. A Manufacturer's engineering report that explains the aircraft manufacturer's methodology used to develop the predicted data and illustrates past successes of the method on similar projects. For example, the manufacturer could show the application of the method to an earlier aircraft model or predict the characteristics of an earlier model and compare the results to final data for that model; and
- b. Early flight test results. This data is often derived from airplane certification tests, and should be used to maximum advantage for early flight simulator validation. Certain critical tests that would normally be done early in the airplane certification program should be included to validate essential pilot training and certification maneuvers. These include cases where a pilot is expected to cope with an airplane failure mode or an engine failure. Flight test data that will be available early in the flight test program will depend on the airplane manufacturer's flight test program design and may not be the same in each case. The flight test program of the airplane manufacturer should include provisions for generation of very early flight test results for flight simulator validation.

Note: A description of airplane manufacturer-provided data needed for flight simulator modeling and validation is to be found in the IATA Document "Flight Simulator Design and Performance Data Requirements," as amended.

- 3.6.6 The MSP may accept certain partially validated preliminary aircraft and systems data, and early release ('red label') avionics in order to permit the necessary programme schedule for training, certification and service introduction. Flight simulator avionics should stay closely in step with airplane avionics (hardware and software) updates. The permitted time lapse between airplane and flight simulator updates should be minimal. It may depend on the magnitude of the update and whether the QTG and pilot training and certification are affected. Differences in airplane and flight simulator avionics versions and the resulting effects on flight simulator qualification should be agreed upon between the simulator sponsor and the MSP. Consultation with the flight simulator manufacturer is desirable throughout the qualification process. The sponsor is responsible for tracking the hardware and software configuration of the FSTD as it relates to the development program and notifying the MSP of updates and modifications as per section [3.4](#).
- 3.6.7 The use of preliminary data is not indefinite. The airplane manufacturer's final data should be available within 12 months after the airplane's first entry into service or as agreed by the MSP, the simulator sponsor, and the airplane manufacturer. When applying for interim qualification using preliminary data, the simulator sponsor and the MSP should agree on the update program. This includes specifying that the final data update will be installed in the flight simulator within a period of 12 months following the final data release, unless special conditions exist and a different schedule is acceptable. The flight simulator performance and handling validation would then be based on data derived from flight tests or from other approved sources. Initial airplane systems data should be updated after engineering tests. Final airplane systems data should also be used for flight simulator programming and validation.
- 3.6.8 The following describes an example of the design data and sources that might be used in the development of an interim qualification plan.
 - a. The plan should consist of the development of a QTG based upon a mix of flight test and engineering simulation data. For data collected from specific airplane flight tests or other flights, the required design model or data changes necessary to support an acceptable Proof of Match (POM) should be generated by the airplane manufacturer.
 - b. For proper validation of the two sets of data, the airplane manufacturer should compare their simulation model responses against the flight test data, when driven by the same control inputs and subjected to the same atmospheric conditions as 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 flight simulator manufacturer:

- 1) Propulsion;
- 2) Aerodynamics;
- 3) Mass properties;
- 4) Flight controls;
- 5) Stability augmentation; and
- 6) Brakes/landing gear.

3.7 Additional qualifications for a currently qualified FSTD

3.7.1 A currently qualified FSTD must undergo an additional qualification process if a user intends to use the FSTD for meeting training, or checking requirements beyond the qualifications originally issued for that FSTD.

3.7.2 **Application process.** The sponsor may apply for additional qualifications as follows:

- a. **Letter of Intent.** Submit a letter of intent to the MSP that;
 - 1) Describes all modifications to the FSTD and identifies all changes to the MQTG that are required to support the additional qualification.
 - 2) Where applicable, attach the Supplemental Type Certificate or AFM information for any system or avionics installed to support the additional qualification.
- b. **Letter of Compliance.** Submitting a “letter of compliance” signed by the management representative no later than 5 working days before the modification is evaluated confirming that:
 - 1) Qualified pilot(s), meeting the requirements of paragraph [3.1.4](#), after having flown the relevant Operations Tasks and determined that the modification or update represent those of the aircraft or set of aircraft within the normal operating envelope. Exceptions, if any, must be noted. The name of the pilot(s) making this determination must be identified on the letter of compliance.
 - 2) Qualified pilot(s), meeting the requirements of paragraph [3.1.4](#), or person(s) trained on simulator systems/sub-systems and trained on the operation of the simulated aircraft systems, after having exercised the operation of the FSTD and the pertinent functions available through the Instructor Operating Station(s) have determined that: FSTD modification or update functionally represents those in the aircraft or set of aircraft; and all affected QTG tests are in tolerance. The name of the person(s) making this determination must be available to the MSP upon request. Exceptions, if any, must be noted.
- c. **Approval.** The MSP will approve the use of an additional qualification when:
 - 1) The FSTD successfully passes a special evaluation according to the scope defined by the MSP in the response to the letter of intent; and
 - 2) The Qualification Certificate has been appropriately amended.

3.8 Continuing FSTD Qualification

3.8.1 To avoid conflicts with the sponsor’s normal FSTD training schedules, the MSP will offer scheduled dates for each recurrent evaluations well in advance of the qualification expiry date. The sponsor remains responsible for ensuring that an evaluation date is confirmed with the MSP no later than 60 days before a continuing evaluation is due.

- 3.8.2 This evaluation consists of objective tests, and subjective tests, including general FSTD requirements, as described in the applicable QPS or as may be amended by an FSTD Directive. Unless previously arranged with the MSP, the sponsor will:
- a. Provide a minimum of 6 hours of FSTD time to complete the evaluation;
 - b. Provide a qualified IOS operator and a qualified pilot to fly the FSTD;
 - c. Provide access to the:
 - 1) MQTG,
 - 2) Discrepancy Log,
 - 3) Results of annual QTG tests required by the applicable QPS, and
 - 4) Any other document requested by the evaluator to show compliance with Compliance Processes.

3.9 Voluntary Suspension

- 3.9.1 The sponsor may remove an FSTD from active status for a period of less than two years. The following procedures apply:
- a. The MSP must be notified in writing and the notification must include an estimate of the period that the FSTD will be inactive;
 - b. Recurrent evaluations will not be scheduled during the inactive period;
 - c. The MSP will remove the FSTD from the list of qualified FSTDs on a mutually established date not later than the date on which the first missed recurrent evaluation would have been scheduled;
 - d. Before the FSTD is restored to qualified status, it must be re-evaluated by the MSP. The evaluation content and the time required to accomplish the evaluation is based on the number of continuing qualification evaluations and sponsor-conducted quarterly inspections missed during the period of inactivity.
 - e. The sponsor must notify the MSP of any updates implemented during the inactive period, and any changes to the original scheduled inactive period;
- 3.9.2 To reinstate the qualification, the sponsor will follow the application process at paragraph [3.3.2](#). The FSTD will normally be re-qualified using the TC approved MQTG and the criteria that was in effect prior to the voluntary suspension. However, inactive periods of 2 years or more will require requalification under the standards in force at the time of requalification.
- 3.9.3 The sponsor may implement updates during the inactive period. If the MSP deems that an evaluation is appropriate or necessary after such an update, the evaluation will be conducted based on the FSTD's original qualification standards.

3.10 Application for an FSTD Qualification under a Bilateral Aviation Safety Agreement (BASA)

- 3.10.1 Pursuant to section 606.03 of the CARs, the Minister may issue a FSTD certificate based on Bilateral Aviation Safety Agreement (BASA) if the provisions at paragraph [2.17.2](#) are satisfied.
- 3.10.2 **Application Procedures** - Requests for a FSTD qualification under a Bilateral Aviation Safety Agreement will be made as follows:
- a. **Initial Qualification.** For initial qualification of an FSTD under a SIP, the sponsor must make a written application to the MSP. The application may be made by letter or email and must include the following information:

- 1) A copy of the latest NAA FSTD evaluation report (if applicable);
 - 2) Documentation defining the FSTD's configuration (QTG information page) and the training qualification profile;
 - 3) The names of Canadian Air Operators applying to use the FSTD;
 - 4) The name of the Transport Canada TPAA for the Canadian Air Operators; and
 - 5) A list of Canadian airports available in the FSTD visual database to support Canadian aircrew training and checking.
- b. **Continuing qualification.** For continuing qualifications, the sponsor must request that the FSTD be continued under the provisions of the SIP and, prior to the expiry of the Transport Canada qualification, provide:
- 1) The most recent NAA FSTD qualification certificate;
 - 2) The most recent NAA evaluation report and Transport Canada special conditions report (if applicable);
 - 3) The names of Canadian Air Operators who used the device since the previous Transport Canada qualification certificate was issued.
- c. Upon receipt, the NESP will review the request to determine if a Transport Canada evaluation of the device is required. If required, the NAA will be requested to conduct an additional evaluation of the Transport Canada special conditions as defined by the SIP.
- d. The NSEP will initiate coordination with the NAA and the local Transport Canada TPAA. The sponsor will be notified by the NSEP when a determination has been made that the FSTD meets or does not meet the requirements to receive a Transport Canada qualification under the terms and conditions of the SIP.
- e. Once the FSTD receives Transport Canada qualification from the NESP, the sponsor will receive a Qualification certificate for the device.

3.10.3 Sponsor Responsibility. The sponsor is responsible for:

- a. Advising the NSEP of any changes in the status of an FSTD qualified based on a BASA, including: relocations; sponsorship change; decommissioning; updates; upgrades; downgrades; and temporary removals from service; and
- b. Post the Qualification Certificate issued by TC NSEP in or adjacent to the FSTD. An electronic copy of the Qualification Certificate that may be accessed by an appropriate terminal or display in or adjacent to the FSTD is satisfactory.
- c. Ensuring that each Canadian Air Operator or Private Operator using the FSTD provides written approval from their TPAA. The sponsor must keep this approval on file and produce it to the MSP upon request.

3.10.4 The Minister reserves the right to suspend or refuse to issue a Transport Canada FSTD qualification if the sponsor fails to comply with application procedures or adhere to sponsor responsibilities.

Chapter 4 - Full Flight Simulator - Qualification Performance Standards

4.1 Overview

- 4.1.1 This chapter describes the qualification performance standards (QPS) for **aeroplane** and **rotorcraft** full flight simulators (FFS) (Level A to Level D). Whenever the term “**aircraft**” is used, it pertains to both aeroplanes and rotorcraft. The QPS main body of Chapter 4 pertains to **aircraft** Flight Simulation Training Devices (FSTDs). The technical requirements and evaluation criteria specific to aeroplane and rotorcraft FSTDs are presented in the following appendices:

A. AEROPLANE FFS - QPS

- a. Appendix A1 – Aeroplane FFS – General Simulator Requirements
- b. Appendix A2 – Aeroplane FFS – Objective Test Requirements
- c. Appendix A3 – Aeroplane FFS – Simulator Subjective Evaluations

B. ROTORCRAFT FFS - QPS

- d. Appendix B1 – Rotorcraft FFS– General Simulator Requirements
- e. Appendix B2 – Rotorcraft FFS– Objective Test Requirements
- f. Appendix B3 – Rotorcraft FFS– Simulator Subjective Evaluations

4.2 Flight Test Validation Data

- 4.2.1 Flight test data used to validate FFS performance and handling qualities must have been gathered in accordance with a flight test program containing the following:

Note: To avoid duplication in this manual, Flight Test Validation Data requirements in this section also apply to type-specific Flight Training Devices (FTD) (Level 5 to 7) QPS described in Chapter 5 of this manual.

- a. A flight test plan consisting of:
 - 1) The maneuvers and procedures required for aircraft certification and simulation programming and validation.
 - 2) For each maneuver or procedure — (i) The procedures and control input the flight test pilot and/or engineer used; (ii) The atmospheric and environmental conditions; (iii) The initial flight conditions; (iv) The aircraft configuration, including weight and center of gravity; (v) The data to be gathered; and (vi) All other information necessary to recreate the flight test conditions in the FSTD.
 - 3) Appropriately qualified flight test personnel.
 - 4) An understanding of the data accuracy requirements when using appropriate alternative data sources, procedures, and instrumentation that is traceable to a recognized standard as described in Appendix A2, Table A2C for aeroplane FFS or Appendix B2 Table B2C for rotorcraft FFS. (For FTD references, refer to Chapter 5).
 - 5) Appropriate and sufficient data acquisition equipment or system(s), including appropriate data reduction and analysis methods and techniques, as would be acceptable to Transport Canada Aircraft Certification.
- b. The data, regardless of source, must be presented:
 - 1) In a format that supports the FSTD validation process.
 - 2) In a manner that is clearly readable and annotated correctly and completely.

- 3) With resolution sufficient to determine compliance with the tolerances set forth in the applicable objective test requirements. (Appendix A2, Table A2A for aeroplane FFS or Appendix B2 Table B2A for rotorcraft FFS. (For FTD references, refer to Chapter 5).
 - 4) With all necessary instructions or other details, (such as yaw damper (for aeroplanes), stability augmentation system (SAS) (for rotorcraft), or throttle position) required to properly interpret the data; and
 - 5) Without alteration, adjustments, or bias. Data may be corrected to address known data calibration errors provided that an explanation of the methods used to correct the errors appears in the QTG. The corrected data may be re-scaled, digitized, or otherwise manipulated to fit the desired presentation.
- c. After completion of any additional flight test, a flight test report must be submitted to augment the validation data. The report must contain sufficient data and rationale to support qualification of the FFS at the level requested.
 - d. As required by paragraph 2.14.4 in Chapter 2 of this manual, the sponsor must notify the Manager, Simulator Program (MSP) of any addition, amendment, or revision to the data that is used to validate performance, handling qualities, or other characteristics of the aircraft, including data related to any relevant changes that occurs after the type certificate was issued. When the Sponsor becomes aware of a change to the data, they must;
 - 1) Within 10 calendar days, notify the MSP of the existence of this data, and
 - 2) Within 45 calendar days, notify the MSP of the schedule to incorporate this data into the FFS, or the reason for not incorporating this data into the FFS.
 - e. In those test cases where the QPS permits a “snapshot” or a “series of snapshot” results in lieu of a time-history, the sponsor or other data provider must ensure that a steady state condition exists from interval of 4 seconds before to 1 second after the time the “snapshot” was captured.

4.3 Engineering Simulator—Validation Data

- 4.3.1 When it is necessary to modify or update a fully validated FSTD (i.e. validated with flight test results) in response to aircraft configuration changes, the aircraft manufacturer or data supplier may seek MSP approval to selectively supplement flight test data with validation data from an “audited” engineering simulator/simulation. Engineering data may only be used for changes that are incremental in nature and the MSP must be provided an opportunity to audit the engineering simulation methods, including the use of an engineering simulator during the data acquisition process.
- 4.3.2 Aircraft manufacturers or other acceptable data suppliers seeking to use an engineering simulator for simulation validation data as an alternative to flight-test derived validation data, must contact the MSP and provide the following:
 - a. A description of the proposed aircraft changes, a description of the proposed simulation model changes, and the use of an integral configuration management process, including an audit of the actual simulation model modifications that includes a step-by-step description leading from the original model(s) to the current model(s).
 - b. A schedule of the proposed plan to acquire and develop the engineering validation data for an MSP review.
 - c. Validation data from an audited engineering simulator/simulation to supplement specific segments of the flight test data.
- 4.3.3 To be qualified to supply engineering simulator validation data, for aerodynamic, engine, flight control, or ground handling models, an aircraft manufacturer or other acceptable data supplier must:

- a. Be able to verify their ability to:
 - 1) Develop and implement high fidelity simulation models; and
 - 2) Predict the handling and performance characteristics of an aircraft with sufficient accuracy to avoid additional flight test activities for those handling and performance characteristics.
- b. Have an engineering simulator that:
 - 1) Is a physical entity, complete with a flight deck representative of the simulated class of aircraft;
 - 2) Has controls sufficient for manual flight;
 - 3) Has models that run in an integrated manner;
 - 4) Had fully flight-test validated simulation models as the original or baseline simulation models;
 - 5) Has an out-of-the-flight deck visual system;
 - 6) Has actual avionics boxes interchangeable with the equivalent software simulations to support validation of released software;
 - 7) Uses the same models as released to the training community (which are also used to produce stand-alone proof-of-match and checkout documents);
 - 8) Is used to support aircraft development and certification; and
 - 9) Has been found to be a high fidelity representation of the aircraft by the manufacturer's pilots (or other acceptable data supplier), certificate holders, and the MSP.
- c. Use the engineering simulator to produce a representative set of integrated proof-of-match cases.
- d. Use a configuration control system covering hardware and software for the operating components of the engineering simulator.
- e. Demonstrate that the predicted effects of the change(s) are within the provisions of subparagraph 4.3.1 of this section, and confirm that additional flight test data are not required.

4.3.4 Additional Requirements for Validation Data

- a. When used to provide validation data, an engineering simulator must meet the simulator standards currently applicable to training simulators except for the data package.
- b. The data package used must be:
 - 1) Comprised of the engineering predictions derived from the aircraft design, development, or certification process;
 - 2) Based on acceptable aeronautical principles with proven success history and valid outcomes for aerodynamics, engine operations, avionics operations, flight control applications, or ground handling;
 - 3) Verified with existing flight-test data; and
 - 4) Applicable to the configuration of a production aircraft, as opposed to a flight-test aircraft.
- c. Where engineering simulator data are used as part of a Qualification Performance Standard (QTG), an essential match must exist between the training simulator and the validation data.
- d. Training flight simulator(s) using these baseline and modified simulation models must be qualified to at least internationally recognized standards, such as contained in the International Civil Aviation Organization (ICAO) Document 9625, the "Manual of Criteria for the Qualification of Flight Simulators."

4.4 Validation Test Tolerances - Non-Flight-Test Data

- 4.4.1 The objective-test tolerances listed in Appendix A2, Table A2A (aeroplanes) and Appendix B2, Table B2A (rotorcraft) provide a measureable means to compare and assess simulator performance against data acquired through actual flight-tests. Good engineering judgment should be applied to all tolerances in any test. A test fails when the results fall outside of the prescribed tolerance(s).
- 4.4.2 In some cases, engineering simulator data or other non-flight-test data sources may be considered if sound technical reasons or high costs prohibit the acquisition of flight-test data, or if alternative technical solutions are being proposed. If the use engineering data or non-flight-test data is allowed, then the data provider must supply a well-documented mathematical model and test procedure.
- 4.4.3 Engineering simulator data is deemed acceptable since the same simulation models used to generate the reference data are also used to test the FTSD. The expected test results from both devices should therefore be very similar. For this reason, the expected tolerance for FSTD objective tests validated using engineering data is reduced to 40% of those tolerances published in this manual for corresponding tests using flight-test data. However, there may be circumstances where the simulator models employed, or the manner in which they are integrated in the test loop, yield a higher fidelity than those supplied by the data provider. In these cases, it is possible that an error greater than 40% may be acceptable if the sponsor can provide adequate explanation. The MSP may accept that the results from the two sources exceed 40% tolerance band based on justification relating to:
- a. Hardware (avionics units and flight controls);
 - b. Iteration rates;
 - c. Execution order;
 - d. Integration methods;
 - e. Processor architecture;
 - f. Digital drift, including:
 - g. Interpolation methods;
 - h. Data handling differences; or
 - i. Auto-test trim tolerances.

4.5 Validation Data Roadmap

- 4.5.1 A Validation Data Roadmap (VDR) is a document that contains guidance material from the data supplier recommending the best possible sources of data to be used as validation data in the QTG. Aircraft manufacturers or other data suppliers must supply a VDR as part of the FSTD validation data package. A VDR is of special value when requesting an interim qualification, a qualification for simulators of aircrafts certificated prior to 1992, or an update qualification for alternate engine or avionics fits. A sponsor seeking to have an FSTD qualified in accordance with the QPS in this manual should submit a VDR to the MSP as early as possible in the planning stages. The MSP is the final authority to approve the data to be used as validation material in the QTG.
- 4.5.2 The VDR should identify (in matrix format) sources of data for all required objective tests. It should also provide guidance regarding the validity of these data for a specific engine type, thrust rating configuration, and the revision levels of all avionics affecting aircraft handling qualities and performance. The VDR should include rationale or explanation in test cases when; data or parameters are missing, engineering simulation data are to be used, flight test methods require

explanation, or there are deviations from data requirements. Additionally, the document should refer to other appropriate sources of validation data (e.g., sound and vibration data documents).

- 4.5.3 A sample Validation Data Roadmap (VDR) is shown in Attachment 4.1 to this Chapter. It depicts a generic roadmap matrix identifying sources of validation data for an abbreviated list of tests. A complete matrix should address all test conditions and provide actual data and data sources.

4.6 Acceptance Guidelines for Alternative Avionics (Flight-Related Computers and Controllers)

- 4.6.1 For a new aircraft type, the majority of flight validation data are collected on the first certified aircraft configuration with a “baseline” avionics ship-set. These data are then used to validate all flight simulators representing that aircraft type. Hardware design changes or software revisions to some baseline avionic systems, components or functionality may significantly alter the aircraft’s response, which in turn may significantly change the FTD performance and QTG results. Examples of such systems are; flight control computers, controllers for engines, autopilots, braking systems, nosewheel steering systems, and related avionics such as augmentation systems.

- 4.6.2 The MSP may require additional validation data for a FSTD with avionic hardware designs that differ from the baseline configuration, or if a software revision differs from a previously validated configuration. The QTG for a FSTD with additional or alternate avionics configurations should contain selected objective test cases and data to validate any significant performance differences attributed to the avionics configuration.

- 4.6.3 **Approval Guidelines for Validating Alternate Avionics.** The MSP will apply the following guidelines when qualifying FSTDs representing aircrafts with a revised avionics configuration, or more than one avionics configuration:

- a. The baseline validation data should be based on flight test data, except where other data are specifically allowed (e.g., engineering flight simulator data).
- b. The sponsor is responsible for determining and disclosing whether validation data used in the QTG is affected by an alternative avionics fit.
- c. Validation data from the previously validated avionics configuration may be used provided that:
 - 1) Avionics system or component changes do not affect QTG results. This includes updates to avionics systems that are tied to aircraft response but do not affect QTG results (e.g., the avionics change is a Built-In-Test-Equipment (BITE) update or a modification in a different flight phase). The QTG should include authoritative justification from the aircraft manufacturer or system supplier that this avionics change does not affect the test; or
 - 2) No new functionality is added and the impact of the avionics change on the aircraft response is demonstrated to be small based on acceptable and proven aeronautical principles. This should be supplemented with avionics-specific validation data from the aircraft manufacturer’s engineering simulation, using the revised avionics configuration. The QTG should include an explanation of the change and its effect on the aircraft response.
- d. Supplemental flight test data is required to validate the alternate avionics revision if:
 - 1) An avionics change significantly affects some QTG results, or
 - 2) New functionality is added to the avionics system.

Note: Additional flight test validation data may not be needed if the avionics changes were certified without the need for testing with a comprehensive flight instrumentation package. The aircraft manufacturer should coordinate flight simulator data requirements in advance with the MSP.

- e. The Validation Road Map in the QTG should be amended to reflect the appropriate validation data source for each test. The roadmap should identify the revision state of the avionics systems that could affect specific test responses.

4.7 Control Dynamics

- 4.7.1 **General.** The characteristics of a flight control system have a major effect on an aircraft's handling qualities. Pilot "feel" is a significant and important consideration when designing and accepting an aircraft flight control system or mechanism so that pilots will be comfortable and will consider the aircraft desirable to fly. In order for an FFS to be representative, it must "feel" like the aircraft being simulated. The fidelity requirements of an FFS control system is determined by recording and comparing the control feel dynamics of the FFS to actual aeroplane measurements taken in takeoff, cruise and landing configurations; or rotorcraft measurements in the hover and cruise configurations.
- 4.7.2 Recordings such as free response to an impulse or step function are classically used to estimate the dynamic properties of electromechanical systems. The ability to accurately estimate the dynamic properties depends how well the true inputs and responses are measured. Therefore, it is imperative that the best possible data be collected so that the FFS control loading system can be tuned to closely match to the aircraft system. The required dynamic control tests are described in Appendix A2, Table A2A (aeroplanes) and Appendix B2, Table B2A (rotorcraft).
- 4.7.3 For initial and upgrade evaluations, the QPS requires that control dynamics characteristics be measured and recorded directly from the flight controls. This procedure is usually accomplished by measuring the free response of the controls using a step or impulse input to excite the system. The procedure should be accomplished:
 - a. For aeroplanes - in the takeoff, cruise and landing flight conditions and configurations (Handling Qualities - Appendix A2, Table A2A), or
 - b. For rotorcraft - in the hover and cruise flight conditions and configurations for rotorcraft (Handling Qualities - Appendix B2, Table B2A).
- 4.7.4 For aircraft 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 or rotorcraft, different flight configurations have like effect on control measurements. Thus, one may suffice for another. If either or both considerations apply, engineering validation or aircraft manufacturer rationale should be submitted as justification for ground tests or for eliminating a particular configuration required in the QPS. For FFSs 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 (e.g., computer plots that were produced concurrently and show satisfactory agreement). Repeat of the alternate method during the initial evaluation satisfies this test requirement.
- 4.7.5 **Control Dynamics Evaluations.** The dynamic properties of control systems are often stated in terms of frequency, damping, and a number of other classical measurements. In order to establish a consistent means of validating test results for FFS control loading, criteria are needed that will clearly define the measurement interpretation and the applied tolerances. 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, the following suggested measurements may be used:
 - a. For Levels C and D simulators. Tests to verify that control feel dynamics represent the aircraft should show that the dynamic damping cycles (free response of the controls) match those of the aircraft within specified tolerances. The MSP recognizes that several different testing methods may be used to verify the control feel dynamic response. The MSP will consider the

merits of testing methods based on reliability and consistency. One acceptable method of evaluating the response and the tolerance to be applied is described below for the underdamped and critically damped cases. A sponsor using this method to comply with the QPS requirements should perform the tests as follows:

- 1) **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 aircraft control system and, consequently, will enjoy the full tolerance specified for that period. The damping tolerance will 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 percent of the total initial displacement should be considered significant. The residual band, labeled $T(A_d)$ on Figure I is ± 5 percent of the initial displacement amplitude A_d from the steady state value of the oscillation. Only oscillations outside the residual band are considered significant. When comparing FFS data to aircraft data, the process should begin by overlaying or aligning the FFS and aircraft steady state values and then comparing amplitudes of oscillation peaks, the time of the first zero crossing, and individual periods of oscillation. The FFS should show the same number of significant overshoots to within one when compared against the aircraft data. The procedure for evaluating the response is illustrated in Figure II.
- 2) **Critically damped and Overdamped Response.** Due to the nature of critically damped and overdamped responses (no overshoots), the time to reach 90 percent of the steady state (neutral point) value should be the same as the aircraft within ± 10 percent. The simulator response must be critically damped also. Figure II illustrates the procedure.
- 3) **Special considerations.** Control systems that exhibit characteristics other than classical overdamped or underdamped responses should meet specified tolerances. In addition, special consideration should be given to ensure that significant trends are maintained.

4.7.6 Tolerances.

- a. The following summarizes the tolerances, “T” for underdamped systems, and “n” is the sequential period of a full cycle of oscillation. See Figure 4-1 of this Chapter for an illustration of the referenced measurements.

Tolerance of	Value
T(P0)	$\pm 10\%$ of P0
T(P1)	$\pm 20\%$ of P1
T(P2)	$\pm 30\%$ of P2
T(Pn)	$\pm 10(n+1)\%$ of Pn
T(An)	$\pm 10\%$ of A1, $\pm 20\%$ of Subsequent Peaks
T(Ad)	$\pm 5\%$ of Ad = residual band
Significant overshoots - First overshoot and ± 1 subsequent overshoots	

- b. The following tolerance applies to critically damped and overdamped systems only. See Figure 4-2 for an illustration of the reference measurements:

Tolerance of	Value
T(P0)	$\pm 10\%$ of P0

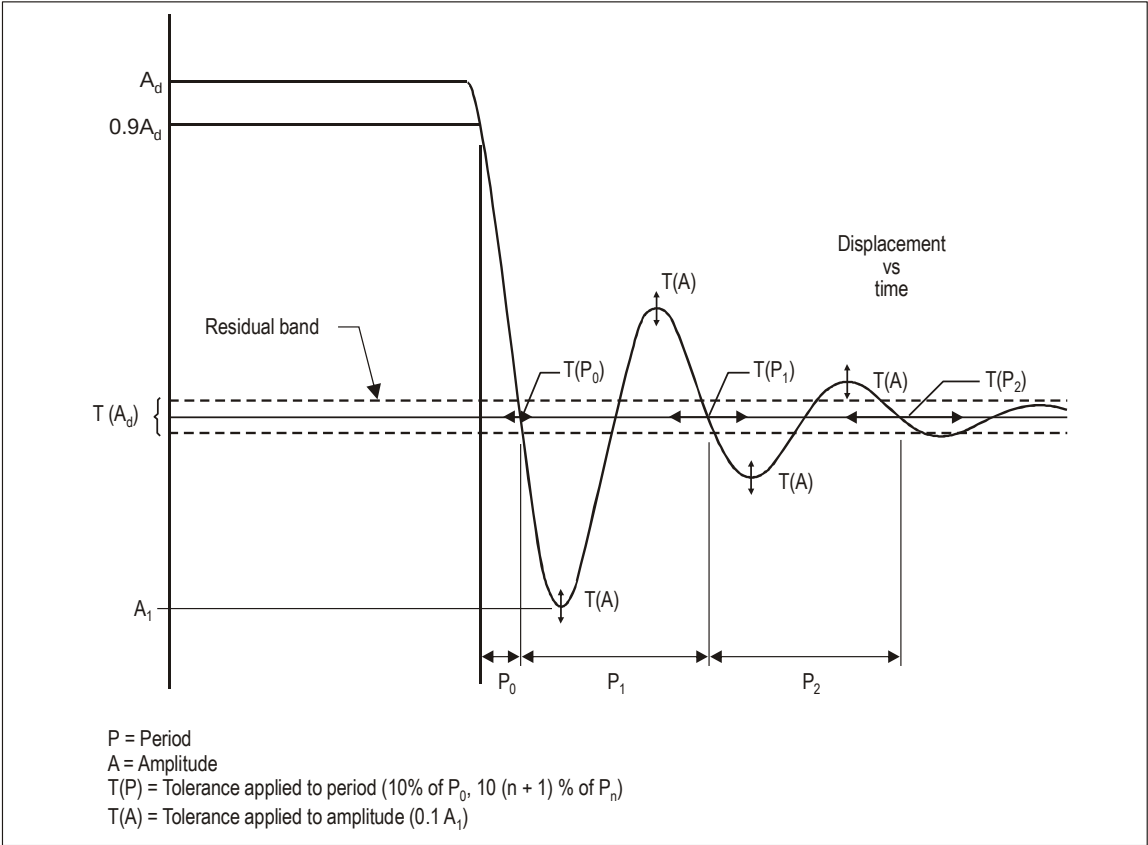
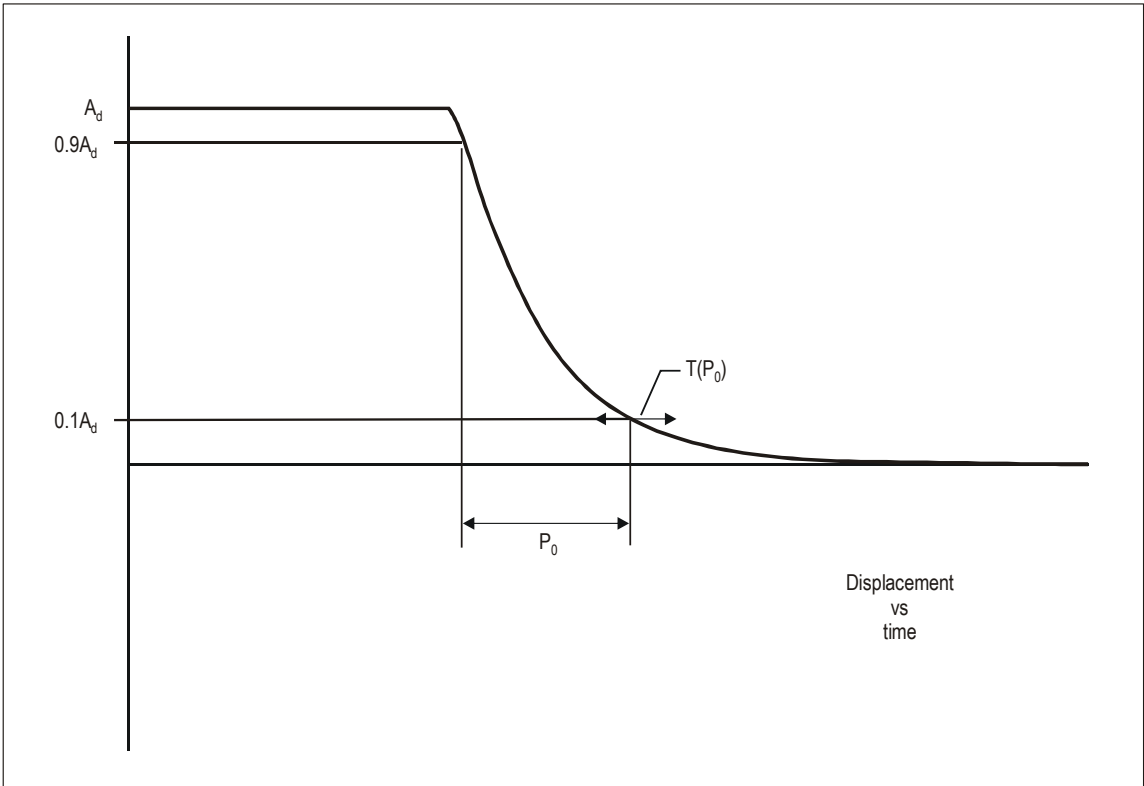


Figure 4-1 - Underdamped step response
Figure 4-2 - Critically damped step response

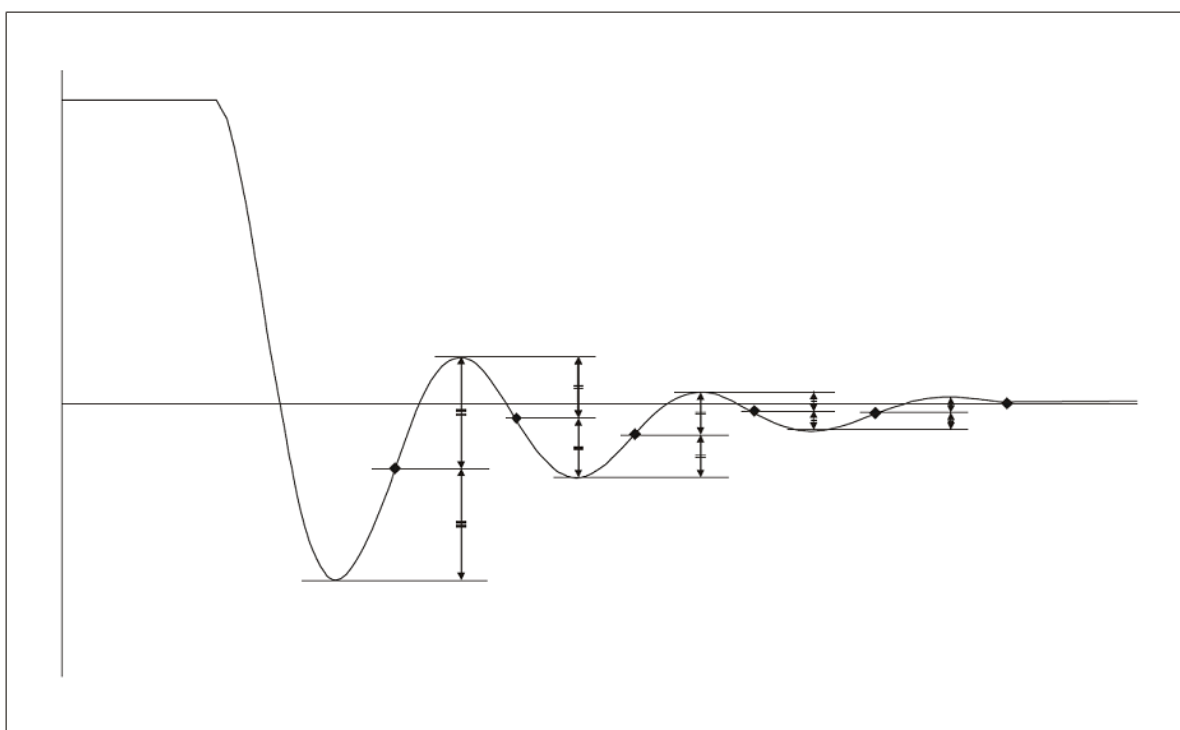


- 4.7.7 The MSP is open to alternative means that are justified and appropriate to the application. For example, the methods described here may not apply to all manufacturers systems and certainly not to aircraft with reversible control systems. Each case will be considered on its own merit on an ad hoc basis. If the MSP finds that alternative methods do not result in satisfactory performance, more conventionally accepted methods will have to be used.
- 4.7.8 **Alternative Method for Control Dynamics Evaluation.** An alternative means for validating control dynamics for aircraft with hydraulically powered flight controls and artificial feel systems is to measure the control force and rate of movement. For each axis of pitch, roll, and yaw, the control must be forced to its maximum extreme position for the following distinct rates. These tests are conducted under normal flight and ground conditions.
- Static test.** Slowly move the control so that a full sweep is achieved within 95-105 seconds. 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.
 - Slow dynamic test.** —Achieve a full sweep within 8-12 seconds.
 - Fast dynamic test.** —Achieve a full sweep in within 3-5 seconds.
- Note:** Dynamic sweeps may be limited to forces not exceeding 100 lbs. (44.5 daN).
- Tolerances
 - 1) Static test—see entries 2.a.1., 2.a.2., and 2.a.3 of Table A2A or B2A, FFS Objective Tests,
 - 2) Dynamic test— ± 2 lbs. (0.9 daN) or $\pm 10\%$ on dynamic increment above static test.
- 4.7.9 **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.
- 4.7.10 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.
- 4.7.11 The following is a full discussion on how to compute the alternate reference line. Figure III shows the final result and how to apply the tolerances using the new reference.
- Background.** When evaluating a flight control dynamic response, the periods, amplitudes and residual band are defined with respect to a reference line, which is the steady state value of the control. This selection is made since it is assumed that the steady state value is representative of the control's rest position throughout the test. For standard irreversible control systems this is very often a valid assumption. However, in the case of reversible control systems for example, aerodynamic forces on the control surfaces influence the instantaneous rest position of the control. During the dynamic test, the control's rest position will vary in response to the variance of the flight conditions. In such a case, the instantaneous rest position and steady state value at the end of the test are not equivalent. When the tolerances are applied to the entire dynamic response based on the steady state value, they may become incorrect and lead to problems evaluating the cases.
 - Alternate Reference Line.** 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. The alternate reference line is obtained as follows:
 - 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 4-3). 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) 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 4-4).
- 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.
- 4) Link all the reference points to obtain the alternate reference line (see Figure 4-4), and append the final non-dynamic portion to it

Note: The rest position is defined as the position where the aeroplane control or rotorcraft blade 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 aircraft



configuration and the accelerations it is subjected to. It will depend on the type of flight control system in the aircraft. 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 of that moment.

Figure 4-3 - Locating median points

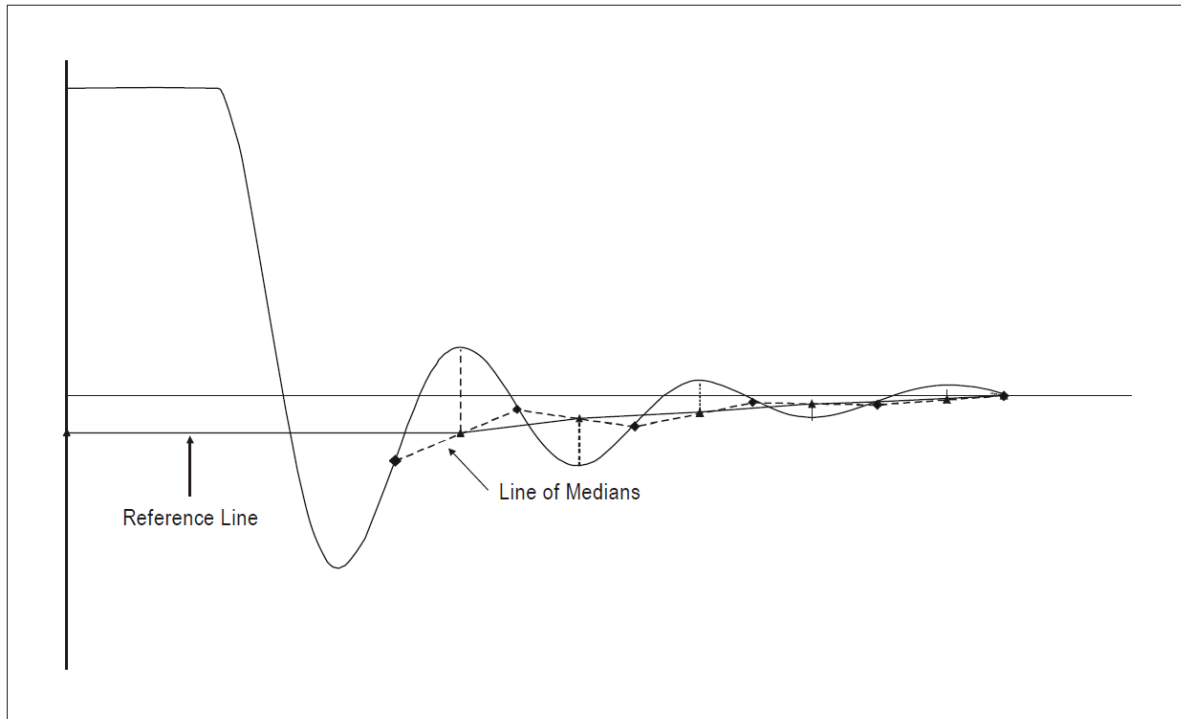


Figure 4-4 - Producing the final alternate reference line

- c.
- d. **Tolerances.** The final alternate reference line (see Figure 4-5) may be used to calculate the conventional tolerances described in paragraph 2b). Note that the residual band $T(A_d)$ must 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.

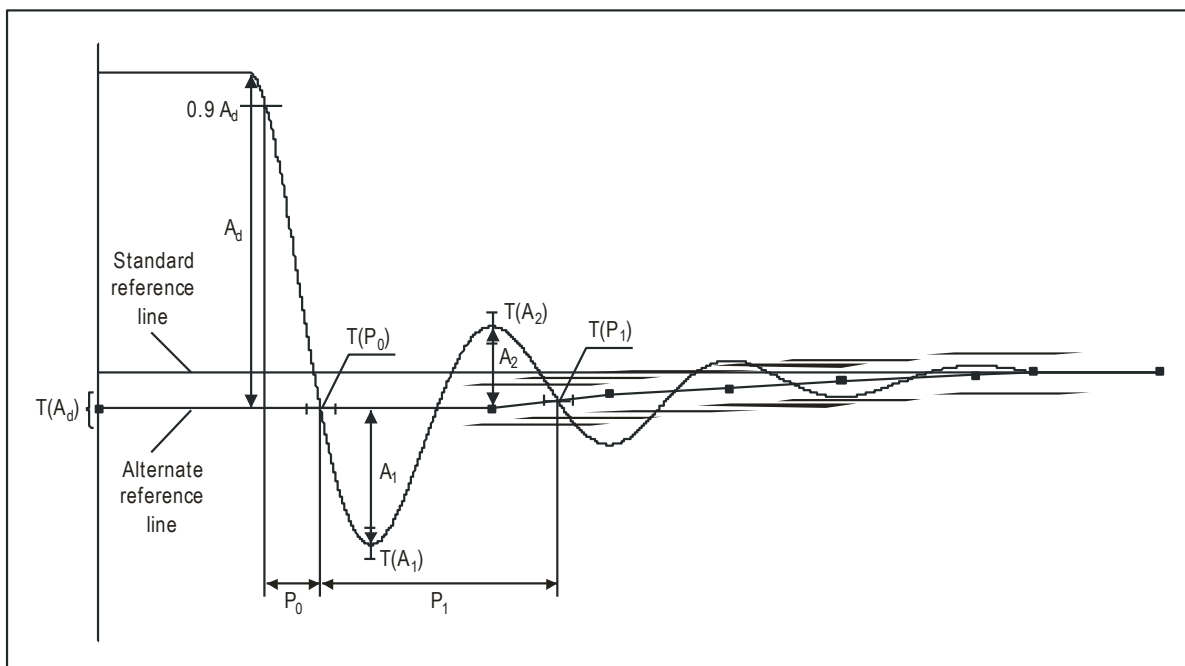


Figure 4-5 Tolerances applied using the alternate reference line

4.8 Ground Effect (Aeroplane Full Flight Simulator Only)

4.8.1 An aeroplane Full Flight Simulator (FFS) to be used for take-off and landing it should reproduce the aerodynamic changes that occur in ground effect. The parameters chosen for FFS validation should indicate these changes.

- a. A dedicated test should be provided that will validate the aerodynamic ground effect characteristics.
- b. The organization performing the flight tests may select appropriate test methods and procedures to validate ground effect. However, the flight tests should be performed with enough duration near the ground to sufficiently validate the ground-effect model.

Note: Ground Effect requirements are not applicable to Level A simulators since landing credits may not be included in Level A simulator training.

4.8.2 The MSP will consider the merits of testing methods based on reliability and consistency. Acceptable methods of validating ground effect are described below. If other methods are proposed, rationale should be provided to conclude that the tests performed validate the ground-effect model. A sponsor using the methods described below to comply with the QPS requirements should perform the tests as follows:

- a. **Level fly-bys.** The level fly-bys should be conducted at a minimum of three altitudes within the ground effect, including one at no more than 10% of the wingspan above the ground, one each at approximately 30% and 50% of the wingspan where height refers to main gear tire above the ground. In addition, one level-flight trim condition should be conducted out of ground effect (e.g., at 150% of wingspan).
- b. **Shallow approach landing.** The shallow approach landing should be performed at a glide slope of approximately one degree with negligible pilot activity until flare.

4.8.3 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 FFS 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 FFS modeling. 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 these tests are accomplished as the aircraft is descending through heights above the runway at which ground effect is an important factor.

4.9 Motion Systems

4.9.1 **General.** Pilots use continuous information signals to regulate the state of the aircraft. In addition to the instruments and outside-world visual information, a FFS must also provide pilots whole-body motion feedback to provide essential vestibular that allow the pilot to quickly and accurately react to aircraft dynamic changes, particularly in the presence of external disturbances.

4.9.2 The motion system should meet basic objective performance criteria, and should be subjectively tuned at the pilot's seat position to represent the linear and angular accelerations of the aircraft during a prescribed minimum set of maneuvers and conditions. The response of the motion cueing system should also be repeatable.

4.9.3 The Motion System tests in Section 3 of Appendix A2 Table A2A (aeroplanes), and Appendix B2, Table B2A (rotorcraft) are intended to qualify the FFS motion cueing system from a mechanical performance standpoint. Additionally, the list of motion effects provides a representative sample of dynamic conditions that should be present in the flight simulator. An additional list of representative, training-critical maneuvers, selected from Section 1 (Performance tests), and Section 2 (Handling Qualities tests), in Table A2A (aeroplanes) and Table B2A (rotorcraft), that should be recorded during initial qualification (but without tolerance) to indicate the flight simulator

motion cueing performance signature have been identified (reference Section 3.e). These tests are intended to help improve the overall standard of FFS motion cueing.

4.9.4 **Motion System Checks.** The intent of test 3a, Frequency Response, and test 3b, Turn-Around Check, as described in the Table of Objective Tests, are 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 robotic tests.

4.9.5 **Motion System Repeatability.** The intent of this test is to ensure that the motion system software and motion system hardware have not degraded or changed over time. This diagnostic test should be completed during continuing qualification checks in lieu of the robotic tests. This will allow an improved ability to determine changes in the software or determine degradation in the hardware. The following information delineates the methodology that should be used for this test.

- a. **Input:** The inputs should be such that rotational accelerations, rotational rates, and linear accelerations are inserted before the transfer from aircraft center of gravity to pilot reference point with a minimum amplitude of 5 deg/sec/sec, 10 deg/sec and 0.3 g, respectively, to provide adequate analysis of the output.
- b. Recommended output:
 - 1) Actual platform linear accelerations; the output will comprise accelerations due to both the linear and rotational motion acceleration;
 - 2) Motion actuators position.
- c. Motion Cueing Performance Signature.
 - 1) **Background.** The intent of this test is to provide quantitative time history records of motion system response to a selected set of automated QTG maneuvers during initial qualification. It is not intended to be a comparison of the motion platform accelerations against the flight test recorded accelerations (i.e., not to be compared against aircraft cueing). If there is a modification to the initially qualified motion software or motion hardware, (e.g., motion washout filter, simulator payload change greater than 10%) then a new baseline may need to be established.
 - 2) **Test Selection.** The “conditions” in Section 3.e. Appendix A2, Table A2A (aeroplanes) and Appendix B2, Table B2A (rotorcraft) are intended to identify those maneuvers where motion cueing is the most discernible. These are general tests applicable to all types of aircraft and should be completed for motion cueing performance signature at any time acceptable to the MSP prior to or during the initial qualification evaluation, and the results included in the MQTG.
 - 3) **Priority.** Motion system should be designed with the intent of placing greater importance on those maneuvers that directly influence pilot perception and control of the aircraft motions. For the maneuvers identified in Section 3.e. Appendix A2, Table A2A (aeroplanes) and Appendix B2, Table B2A (rotorcraft), the flight simulator motion cueing system should have a high tilt co-ordination gain, high rotational gain, and high correlation with respect to the aircraft simulation model.
 - 4) **Data Recording.** The minimum list of parameters provided should allow for the determination of the flight simulator's motion cueing performance signature for the initial qualification evaluation. The following parameters are recommended as being acceptable to perform such a function:
 - 5) Flight model acceleration and rotational rate commands at the pilot reference point;
 - 6) Motion actuators position;
 - 7) Actual platform position;
 - 8) Actual platform acceleration at pilot reference point.

4.9.6 Motion Vibrations.

- a. **Presentation of results.** The characteristic motion vibrations may be used to verify that the flight simulator can reproduce the frequency content of the aircraft 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 aircraft data and flight simulator data should be presented in the same format with the same scaling. The algorithms used for generating the flight simulator data should be the same as those used for the aircraft data. If they are not the same then the algorithms used for the flight simulator data should be proven to be sufficiently comparable. As a minimum, the results along the dominant axes should be presented and a rationale for not presenting the other axes should be provided.
- b. **Interpretation of results.** The overall trend of the PSD plot should be considered while focusing on the dominant frequencies. Less emphasis should be placed on the differences at the high frequency and low amplitude portions of the PSD plot. During the analysis, certain structural components of the flight simulator have resonant frequencies that are filtered and may not appear in the PSD plot. If 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 aircraft data as described below. However, if the PSD plot was altered for subjective reasons, 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. For example, a 1×10^{-3} g-rms²/Hz would describe a heavy buffet and may be seen in the deep stall regime. Alternatively, a 1×10^{-6} g-rms²/Hz buffet is almost not perceivable; but may represent a flap buffet at low speed. The previous two examples differ in magnitude by 1000. On a PSD plot this represents three decades (one decade is a change in order of magnitude of 10; and two decades is a change in order of magnitude of 100).

Note: In the example, “g-rms²” is the mathematical expression for “g’s root mean squared.” Initial (and Upgrade) Qualification Requirements

4.10 Sound System

- 4.10.1 **General.** The total sound environment in the aircraft is very complex, and changes with atmospheric conditions, aircraft configuration, airspeed, altitude, and power settings. Flight deck sounds are an important component of the flight deck operational environment and 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 flight simulator should provide flight deck sounds that are perceptible to the pilot during normal and abnormal operations, and that are comparable to those of the aircraft. The flight simulator operator should carefully evaluate background noises in the location where the device will be installed. To demonstrate compliance with the sound requirements, the objective or validation tests in the applicable QPS were selected to provide a representative sample of normal static conditions typically experienced by a pilot.
- 4.10.2 **Alternate propulsion.** For FFS with multiple propulsion configurations, any condition listed in Table A2A (aeroplane) or B2A (rotorcraft) should be presented for evaluation as part of the QTG if identified by the aircraft manufacturer or other data supplier as significantly different due to a change in propulsion system (engine or propeller).
- 4.10.3 **Data and Data Collection System.**
 - a. Information provided to the flight simulator manufacturer should comply be presented in the format suggested by the “International Air Transport Association (IATA) Flight Simulator Design and Performance Data Requirements,” as amended. This information should contain calibration and frequency response data.

- b. The system used to perform the tests listed in Table A2A (aeroplane) or B2A (rotorcraft) should comply with the following standards:
 - 1) The specifications for octave, half octave, and third octave band filter sets may be found in American National Standards Institute (ANSI) S1.11-1986.
 - 2) Measurement microphones should be type WS2 or better, as described in International Electro-technical Commission (IEC) 1094-4-1995.
 - c. **Headsets.** If headsets are used during normal operation of the aircraft they should also be used during the flight simulator evaluation.
 - d. **Playback equipment.** Playback equipment and recordings of the QTG conditions should be provided during initial evaluations.
 - e. Background noise.
 - 1) Background noise is the noise in the flight simulator that is not associated with the aircraft, but is caused by the flight simulator's cooling and hydraulic systems and extraneous noise from other locations in the building. Background noise can seriously impact the correct simulation of aircraft sounds, and should be kept below the aircraft sounds. In some cases, the sound level of the simulation can be increased to compensate for the background noise. However, this approach is limited by the specified tolerances and by the subjective acceptability of the sound environment to the evaluation pilot.
 - 2) The acceptability of the background noise levels is dependent upon the normal sound levels in the aircraft being represented. Background noise levels that fall below the lines defined by the following points, may be acceptable:
 - 70 dB @ 50 Hz;
 - 55 dB @ 1000 Hz;
 - 30 dB @ 16 kHz.
- Note:** These limits are for un-weighted 1/3 octave band sound levels. Meeting these limits for background noise does not ensure an acceptable flight simulator. Aircraft sounds that fall below this limit require careful review and may require lower limits on background noise.
- f. **Validation testing.** Deficiencies in aircraft recordings should be considered when applying the specified tolerances to ensure that the simulation is representative of the aircraft. Examples of typical deficiencies are:
 - 1) Variation of data between tail numbers.
 - 2) Frequency response of microphones.
 - 3) Repeatability of the measurements.

Table 4A - Example of Continuing Qualification Frequency Response Test Tolerance.

Band Center Frequency	Initial Results (dBSPL)	Continuing qualification 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

Table 4A - Example of Continuing Qualification Frequency Response Test Tolerance.			
315	79.5	78.3	1.2
400	80.1	79.5	0.9
500	80.7	79.8	0.9
630	81.9	80.4	1.5
800	73.2	74.1	0.9
1000	79.2	80.1	0.9
1250	80.7	82.8	2.1
1600	81.6	78.6	3.0
2000	76.2	74.4	1.8
2500	79.5	80.7	1.2
3150	80.1	77.1	3.0
4000	78.9	78.6	0.3
5000	80.1	77.1	3.0
6300	80.7	80.4	0.3
8000	84.3	85.5	1.2
10000	81.3	79.8	1.5
12500	80.7	80.1	0.6
16000	71.1	71.1	0.0
Average	NA	NA	1.1

4.11 Transport Delay Testing

- 4.11.1 The following explains how to measure the “total transport delay” and “introduced-transport delay” (induced by the flight simulator systems) to determine whether overall system time response time does not exceed QPS tolerance requirements. The transport delay should be measured from control inputs through the interface, through each of the host computer modules and back through the interface to motion, flight instrument, and visual systems.
- 4.11.2 Measurement of transport delay and application of QPS tolerances will depend on the FSTD system architecture, which can be categorized as follows:
- Simulation of classic non-computer controlled aircraft.** Figure 4-6 illustrates the total transport delay for a non-computer-controlled aircraft or the classic transport delay test.
 - Introduced transport delay is measured from the flight deck control input to the reaction of the instruments and motion and visual systems.
 - Since there are no aircraft-induced delays for this case, the total transport delay is equivalent to the introduced delay.
 - Simulation of computer controlled aircraft using real aircraft controller black boxes.** Figure 4-7 illustrates the transport delay testing method using the real aircraft controller system.
 - The control input may also be introduced after the aircraft controller system and the introduced transport delay measured directly from the flight control interface input to the reaction of the instruments, and simulator motion and visual systems.
 - To obtain the introduced transport delay for the motion, instrument and visual signal, the delay induced by the aircraft controller should be subtracted from the total transport delay.
 - This difference represents the introduced delay and should not exceed the standards prescribed in Appendix A1, Table A1A (aeroplanes) or Appendix B1, Table B1A (rotorcraft).
 - Simulation of computer controlled aircraft using software emulation of aircraft boxes.** Figure 4-8 illustrates the transport delay testing method used on a flight simulator that uses a software emulated aircraft controller system.

- 1) It is not possible to measure the introduced transport delay using the simulated aircraft controller system architecture for the pitch, roll and yaw axes. Therefore, the signal should be measured directly from the pilot controller.
 - 2) The flight simulator manufacturer should measure the total transport delay and subtract the inherent delay of the actual aircraft components because the real aircraft controller system has an inherent delay provided by the aircraft manufacturer.
 - 3) The flight simulator manufacturer should ensure that the introduced delay does not exceed the standards prescribed in Appendix A1, Table A1A (aeroplanes) or Appendix B1, Table B1A (rotorcraft).
- d. **Simulation using software avionics or re-hosted instruments.** Special measurements for instrument signals are required for flight simulators using a real aircraft instrument system or simulated or re-hosted instruments. Figures 4-9a and 4-9b illustrate the transport delay testing method for each case.
- 1) Figure 4-9a illustrates the transport delay measurement for a real aircraft instrument display system (without aircraft display simulation). The introduced transport delay is the delay between the control movement and the instrument change on the data bus and is obtained by subtracting the inherent delay of the actual aircraft components from the total transport delay. The inherent delay of the aircraft between the data bus and the displays is indicated in figure 4-9. The display manufacturer should provide this delay time.
 - 2) Figure 4-9b illustrates the modified testing method required to measure introduced transport delay due to software avionics or re-hosted instruments. The total simulated instrument transport delay is measured and the aircraft hardware delay is subtracted from this total. This difference represents the introduced transport delay.
 - 3) The introduced delay should not exceed the tolerances in Table A1A (aeroplanes) or B1A (rotorcraft).

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

4.11.4 **Interpretation of results.** Flight simulator results vary over time from test to test due to “sampling uncertainty.” All flight simulators run at a specific rate where all modules are executed sequentially in the host computer. The flight controls input can occur at any time in the iteration, but these data will not be processed before the start of the new iteration. For example, a flight simulator running at 60 Hz may have a difference of as much as 16.67 msec. between test results. This does not mean that the test has failed. Instead, the difference is attributed to variations in input processing. In some conditions, the host simulator and the visual system do not run at the same iteration rate, so the output of the host computer to the visual system will not always be synchronized.

4.11.5 The transport delay test should account for both daylight and night modes of operation of the visual system. In both cases, the tolerances prescribed in Table A1A must be met and the motion response should occur before the end of the first video scan containing new information.

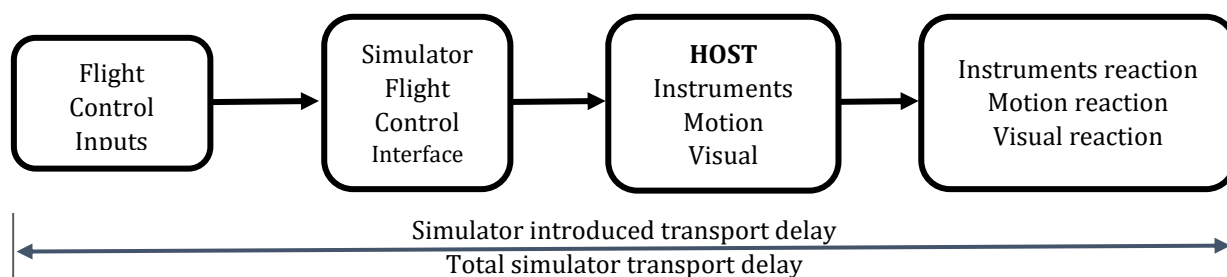
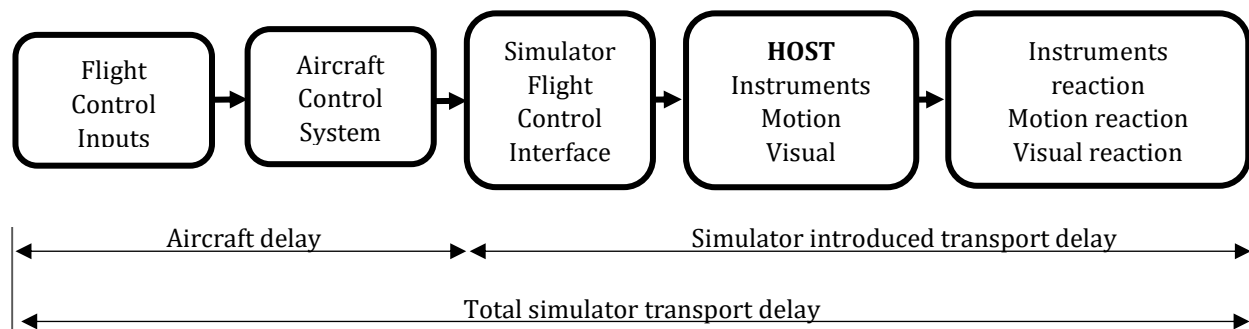
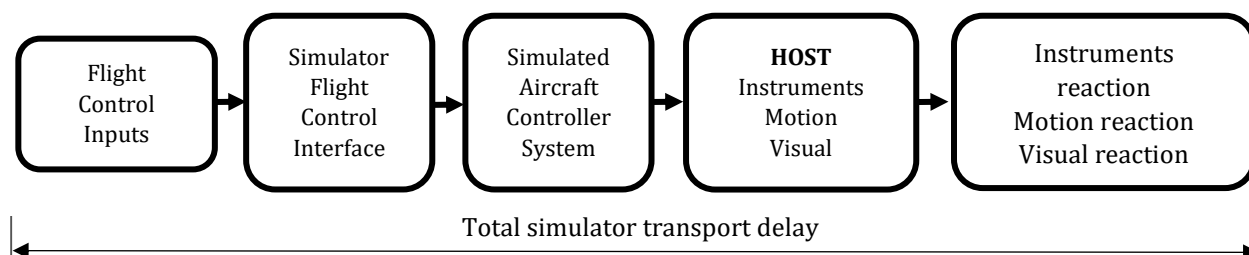
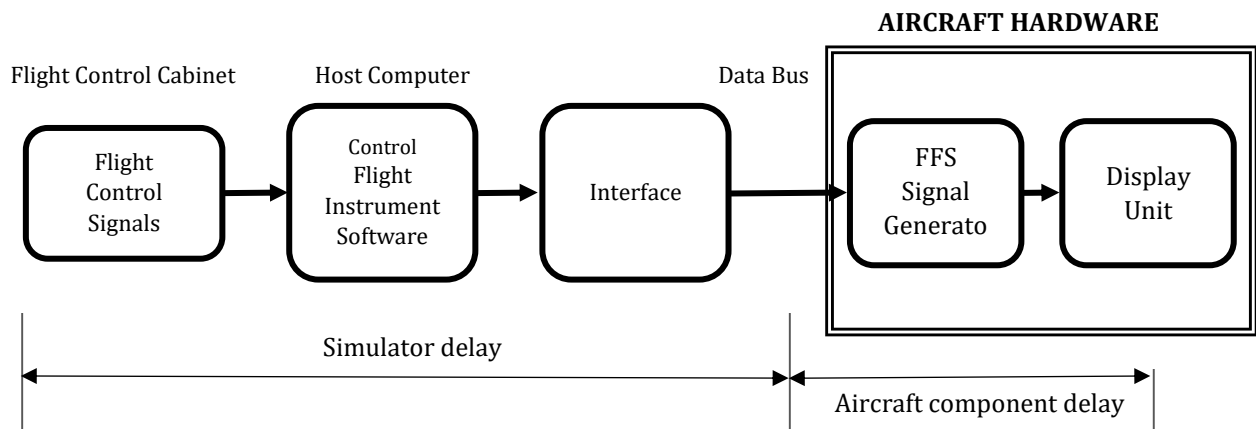
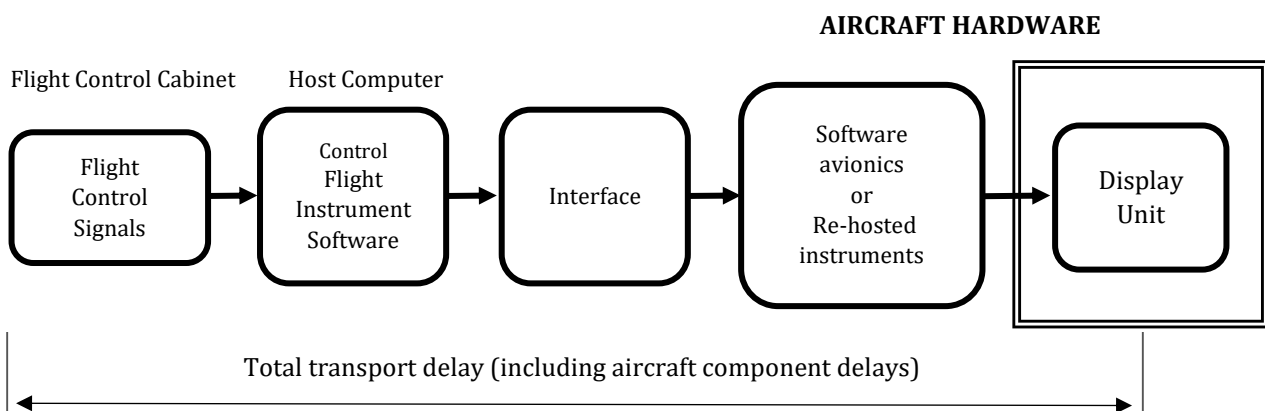
Figure 4.6 – Transport delay for simulation of classic non-computer controlled aircraft.**Figure 4.7 – Transport delay for simulation of computer controlled aircraft using real aircraft black boxes****Figure 4.8 – Transport delay for simulation of computer controlled aircraft using software emulation of aircraft black boxes**

Figure 4.9a – Transport delay for simulation of aircraft using real aircraft instruments**Figure 4.9b – Transport delay using software avionics or re-hosted instruments.**

4.12 Visual Display Systems

4.12.1 This section applies to all FSTDs with a cross-cockpit display installation, meaning a display that can be viewed as a continuous image from any location in the cockpit. For the purpose of this section:

- “Collimated display”** will be used as a generic term for a display system that provides an image apparently located at a distance substantially further away from the pilot than the physical dimensions of the display system, and
- “Direct projected display”** refers to a display system with an image actually located on a screen in front of the pilot.

4.12.2 **Collimated display:** This is a display system that projects its image on a screen via a large concave mirror. The position and curvature of the mirror places an image on the screen that appears at a distance greater than 10 m (33 ft) from the observer. This is the maximum distance that human eyes can effectively judge distance using binocular cues (stereopsis), beyond which all rays from the object are perceived as being effectively parallel. The collimated display causes the viewer's eyes to focus at infinity creating an illusion that objects are located at a distance (see

Figure 4-10). As a result, regardless of the viewing angle or eye point position, objects projected at a significant distance from the viewer will behave geometrically in the same way as they would in the real world. Typically, a collimated display provides an image located not closer than about 20-33 ft (6-10 m) from the viewer, with the distance varying over the field-of-view.

- a. Collimated displays are well suited to many simulation applications where the area of interest is located relatively distant from the observer and the viewing angles to objects are effectively independent of the cockpit eye point position. Consider the view of the runway seen by the flight crew lined up on an approach. In the real world, the runway is distant and the light rays from the runway to the eyes are parallel (see Figure 4-10). The runway appears to be straight ahead from both flight crew positions. Note that the distance to the runway has been shortened for clarity. If drawn to scale, the runway would be farther away and the rays from the two seats would be closer to being parallel.
- b. While the horizontal field-of-view of a collimated display can be extended to approximately 210°-220°, the vertical field-of-view has been limited to about 40°-45°. These limitations result from tradeoffs in optical quality and interference between the display components and flight deck structures, but were sufficient to meet FFS regulatory approval for rotorcraft FFSs. However, recent designs have been introduced with vertical fields of view of up to 60° for rotorcraft applications.

4.12.3

Direct projected display: This is a non-collimated (or dome) display system that projects the image directly onto a screen approximately 3m from the observer. The screen may be cylindrical or spherical in shape, depending on the field of view required. From the observer's perspective, the image will appear and behave as if all the objects in the scene are located on the screen surface. When compared to a collimated display, the orientation of the image presented by a direct projected display will change with the pilot's viewing angles; however it will produce a more representative image at near-field viewing.

- a. The effect of viewing angle in a direct projected display is shown in Figure 4-11. The image orientation can be aligned for only one eye point at a time. The visual system in the Figure 4-11 has been aligned for the right seat eye point position and the runway appears to be straight ahead of the aircraft for this viewer. For the left seat viewer, however, the runway appears to be somewhat to the right of the aircraft. When the aircraft moves towards the runway, the velocity vector will be directed towards the runway and the left-seat pilot will perceive a yaw offset.
- b. In the case of near field objects, a collimated display will cause the pilot to misinterpret objects that are close to the aircraft as being at a distance. This perception error can be significantly reduced in a direct projected display, making the visual simulation close to the ground, typically encountered in rotorcraft operational training, more representative.
- c. The field-of-view possible with a direct projected display can be larger than that of a collimated display. Depending on the configuration, a field-of-view of 240° by 90° is possible and can be exceeded.

Note: The minimum radius of the screen and the position of the cockpit relative to the screen may be determined from the allowed angular errors for the pilot(s). In the example illustrated by Figure 4-12, if the criterion is to have no more than 10° offset for both pilots simultaneously, then for an eye point at the centre of a spherical screen, where the pilots' eye spacing is a typical 1.168 m (46 in.), the screen radius must be at least $1.168/(2 \cdot \tan 10^\circ) = 3.312 \text{ m}$ (10.9 ft).

4.12.4

Additional display considerations

- a. While the situations described above are for discrete viewing positions, the same arguments can be extended to moving eye points produced by the viewer's head movement. In the real world, the parallax effects resulting from head movement provide distance cues. The effect is particularly strong for relative movement of flight deck structure in the near field and modeled

objects in the distance. Collimated displays will provide accurate parallax cues for distant objects, but increasingly inaccurate cues for near field objects. The situation is reversed for dome displays.

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

4.12.5 Training implications

- a. In view of the basic principles described above, it is clear that neither display approach provides a completely accurate image for all possible object distances. The sponsor should consider the training role of the FFS when configuring the display system to make the optimum choice. Factors that should be considered include relative importance of training tasks at low altitudes, the role of the two crew members in the flying tasks, and the field-of-view required for specific training tasks.
- b. Both display types have their strengths, and any choice will be a “trade-off” to gain the best fit to the training requirement. The topics can be summarized as:
- c. The image distance issues do not represent the only factor to be considered. Neither display type is ideal for rotorcraft simulation. The availability of peripheral cues and the level of details in the scene are also very important. Rich scene information is now available from high quality image generators and this capability is likely to improve.
- d. When an operation is required with a crew of two pilots, collimated displays may be the preferred choice unless a large vertical field of view is essential.
- e. For single pilot operation, direct projection is likely to be the optimum solution.
- f. If a direct projected system is used for a multi-pilot operation then one pilot would be designated as “pilot flying” and the other as “pilot not flying”. The image generator could then be set up to ensure that only the pilot flying has the correct view (bearing in mind that the maximum offset allowed for the pilot not flying is 20°). Should it be required to switch the “pilot flying” function to the other pilot, the image could be re-aligned to give the correct view to the new “pilot flying” eye point. A two-pilot training operation using a direct projection system may be best served without offsetting the eye point, i.e. with both pilots having up to 10° offset.
- g. The TPAA's decision on when to permit a centrally aligned display for pilot training and checking will depend upon:
 - 1) The criticality of the specific training or checking maneuver;
 - 2) The need for the handling pilot to use linear visual features; and
 - 3) The need to reinforce an effective skill transfer for maneuvers that can only be trained or checked in the FSTD.

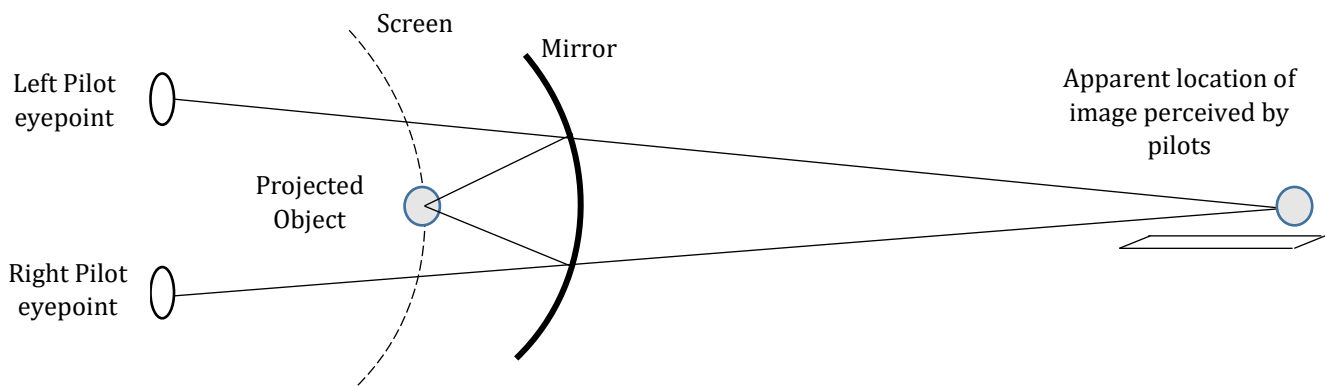


Figure 4-10 – Collimated Display

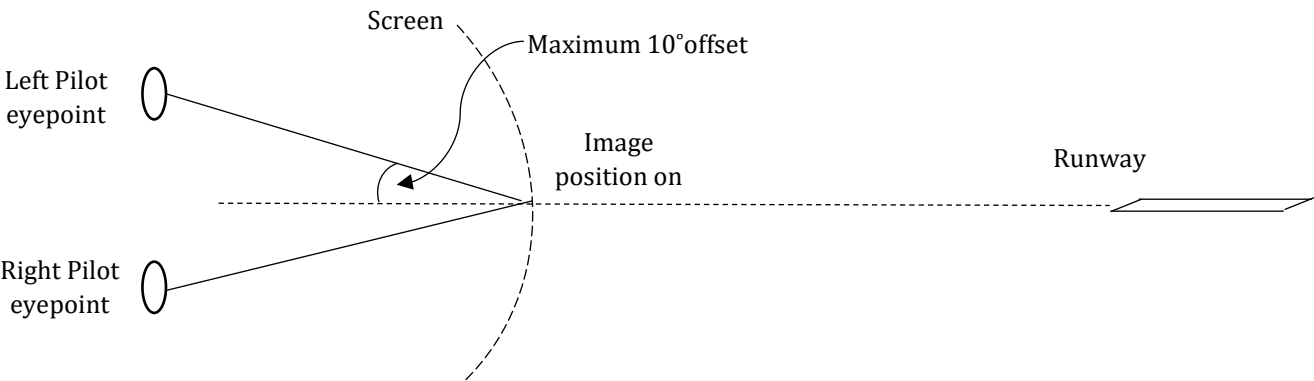


Figure 4-12 – Direct Projected – Centrally Aligned Display

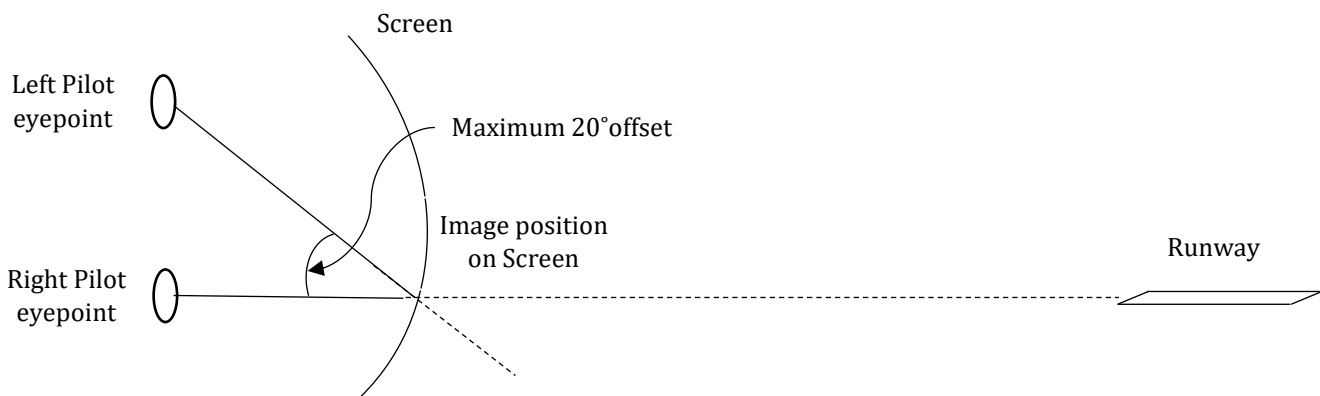


Figure 4-11 – Direct Projected Display

4.13 Visual Scene Requirements.

- 4.13.1 When the simulator is being used by an instructor or evaluator for purposes of training, checking, or testing under this chapter, only airport models classified as Class I, Class II, or Class III may be used by the instructor or evaluator. These classification of airport models are defined as follows:
- Class I.** Whether modeling real world or fictional airports (or landing areas for helicopters), these airport models (or landing areas for helicopters) are those that meet the requirements of Table A3B of Appendix A3 for aeroplanes and Table B3B of Appendix B3 for rotorcraft, as appropriate, and are evaluated by the National Simulator Evaluation Program (NSEP), and are listed on the FSTD Qualification Certificate.
 - Class II.** Whether modeling real world or fictional airports (or landing areas for helicopters), these airport models (or landing areas for helicopters) are those models that are in excess of those used for simulator qualification at a specified level. The FSTD sponsor is responsible for determining that these models meet the requirements set out in Table A3C of Appendix A3 for aeroplanes and Table B3C of Appendix B3 for rotorcraft, as appropriate.
 - Class III.** This is a special class of airport model (or landing area for helicopters), used for specific purposes, and includes models that may be incomplete or inaccurate when viewed without restriction, but when appropriate limits are applied (e.g., “valid for use only in visibility conditions less than 1/2 statute mile or RVR2400 feet,” “valid for use only for approaches to Runway 22L and 22R”), those features that may be incomplete or inaccurate may not be able to be recognized as such by the crewmember being trained, tested, or checked. Class III airport models used for training, testing, or checking activities under this Chapter requires the certificate holder to submit to the TPAA an appropriate analysis of the skills, knowledge, and abilities necessary for competent performance of the task(s) in which this particular model is to be used, and requires TPAA acceptance of each Class III model.
- 4.13.2 Except for special use airport models, described as Class III, all airport models required by this chapter must be representations of real-world, operational airports or representations of fictional airports and must meet the requirements set out in Tables A3B or A3C of Appendix A3 for aeroplanes and Tables B3B or B3C of Appendix B3 for rotorcraft, as appropriate.
- 4.13.3 If fictional airports are used, the sponsor must ensure that navigational aids and all appropriate maps, charts, and other navigational reference material for the fictional airports (and surrounding areas as necessary) are compatible, complete, and accurate with respect to the visual presentation of the airport model of this fictional airport. An SOC must be submitted that addresses navigation aid installation and performance and other criteria (including obstruction clearance protection) for all instrument approaches to the fictional airports that are available in the simulator. The FSTD Qualification Certificate must reference and account for information in the terminal instrument procedures manual and the construction and availability of the required maps, charts, and other navigational material. This material must be clearly marked “for training purposes only.”
- 4.13.4 Neither Class II nor Class III airport visual models are required to appear on the FSTD Qualification Certificate. The sponsor is responsible for keeping instructors and evaluators apprised of the airport models that meet Class II or Class III requirements on any given simulator. The method or process used by the sponsor to achieve this must be available for review by the TPAA and NSEP. Class II models may be subject to review during recurrent evaluations.
- 4.13.5 When an airport model represents a real world airport and a permanent change is made to that real world airport (e.g., a new runway, an extended taxiway, a new lighting system, a runway closure) without a written extension grant from the MSP (described in paragraph 4.13.6 of this section), an update to that airport model must be made in accordance with the following time limits:
- For a new airport runway, a runway extension, a new airport taxiway, a taxiway extension, or a runway/taxiway closure—within 90 days of the opening for use of the new airport runway,

runway extension, new airport taxiway, or taxiway extension; or within 90 days of the closure of the runway or taxiway.

- b. For a new or modified approach light system—within 45 days of the activation of the new or modified approach light system.
- c. For other facility or structural changes on the airport (e.g., new terminal, relocation of Air Traffic Control Tower)—within 180 days of the opening of the new or changed facility or structure.

4.13.6 If a sponsor desires an extension to the time limit for an update to a visual scene or airport model or has an objection to what must be updated in the specific airport model requirement, the sponsor must provide a written extension request to the MSP stating the reason for the update delay and a proposed completion date, or explain why the update is not necessary. The MSP will track the status of the extension by amending the latest recurrent evaluation report and using NSEP simulator oversight procedures.

4.13.7 A Training Program Approval Authority (TPAA) may accept a Class III airport model without individual observation provided the sponsor provides the TPAA with an acceptable description of the process for determining the acceptability of a specific airport model, outlines the conditions under which such an airport model may be used, and adequately describes what restrictions will be applied to each resulting airport or landing area model. Examples of situations that may warrant Class III model designation by the TPAA include the following:

- a. Training, testing, or checking on very low visibility operations, including Surface Movement Guidance and Control System (SMGCS) operations;
- b. Instrument operations training (including instrument takeoff, departure, arrival, approach, and missed approach training, testing, or checking) using:
 - 1) A specific model that has been geographically “moved” to a different location and aligned with an instrument procedure for another airport.
 - 2) A model that does not match changes made at the real-world airport (or landing area for rotorcrafts) being modeled.
 - 3) A model generated with an “off-board” or an “on-board” model development tool (by providing proper latitude/longitude reference; correct runway or landing area orientation, length, width, marking, and lighting information; and appropriate adjacent taxiway location) to generate a facsimile of a real world airport or landing area.

4.13.8 Previously qualified simulators with certain early generation Computer Generated Image (CGI) visual systems, are limited by the capability of the Image Generator or the display system used. These systems are:

- a. Early CGI visual systems that are excepted from the requirement of including runway numbers as a part of the specific runway marking requirements are:
 - 1) Link NVS and DNVS.
 - 2) Novoview 2500 and 6000.
 - 3) FlightSafety VITAL series up to, and including, VITAL III, but not beyond.163
 - 4) Redifusion SP1, SP1T, and SP2.
- b. Early CGI visual systems are exempted from the requirement of including runway numbers unless the runways are used for Line Oriented Flight Training (LOFT) training sessions. These LOFT airport models require runway numbers but only for the specific runway end (one direction) used in the LOFT session. The systems required to display runway numbers only for LOFT scenes are:
 - 1) FlightSafety VITAL IV.

- 2) Redifusion SP3 and SP3T.
- 3) Link-Miles Image II.
- c. The following list of previously qualified CGI and display systems are incapable of generating blue lights. These systems are not required to have accurate taxi-way edge lighting:
 - 1) Redifusion SP1.
 - 2) FlightSafety Vital IV.
 - 3) Link-Miles Image II and Image IIT
 - 4) XKD displays (even though the XKD image generator is capable of generating blue colored lights, the display cannot accommodate that color).

4.14 Initial (and Upgrade) Qualification Requirements

- 4.14.1 In order to be qualified at a particular qualification level, the FFS must:
 - a. Meet the general requirements at Appendix A1 for aeroplanes, or Appendix B1 for rotorcrafts;
 - b. Meet the objective testing requirements at Appendix A2 for aeroplanes, or Appendix B2, 4B2 for rotorcrafts; and
 - c. Satisfactorily accomplish the subjective tests at Appendix A3 for aeroplanes, or Appendix B3 for rotorcrafts.
- 4.14.2 The request described in Chapter 3, Section 3.3 of this manual must include all of the following:
 - a. A statement that the FFS meets all of the applicable provisions of this part and all applicable provisions of the QPS.
 - b. Unless otherwise authorized through prior coordination with the MSP, a letter of compliance that the sponsor will forward to the MSP the statement described in paragraph 3.3.3 of this manual no later than 5 business days prior to the scheduled.
 - c. A QTG, acceptable to the MSP, that includes all of the following:
 - 1) Objective data obtained from aircraft testing or another approved source.
 - 2) Correlating objective test results obtained from the performance of the FFS as prescribed in the appropriate QPS.
 - 3) The result of FFS subjective tests prescribed in the appropriate QPS.
 - 4) A description of the equipment necessary to perform the evaluation for initial qualification and the continuing qualification evaluations.
- 4.14.3 The QTG described in paragraph [4.14.2](#) of this section, must provide the documented proof of compliance with the simulator objective tests in Appendix A2, Table A2A for aeroplanes, or Appendix B2, Table B2A for rotorcraft.
- 4.14.4 The QTG is prepared and submitted by the sponsor, or the sponsor's agent on behalf of the sponsor, to the MSP for review and approval, and must include, for each objective test:
 - a. Parameters, tolerances, and flight conditions.
 - b. Pertinent and complete instructions for the conduct of automatic and manual tests.
 - c. A means of comparing the FFS test results to the objective data.
 - d. Any other information as necessary, to assist in the evaluation of the test results.
 - e. Other information appropriate to the qualification level of the FFS.
- 4.14.5 The QTG must include the following:

- a. A QTG cover page with sponsor and Transport Canada approval signature blocks (The sponsor may contact the MSP for a sample cover-page).
- b. An FFS information page that provides the information listed in this paragraph (The sponsor may contact the MSP for a sample information page). For convertible FFSs, the sponsor must submit a separate page for each configuration of the FFS.
- c. The sponsor's FFS identification number or code.
- d. The aircraft model and series being simulated.
- e. The aerodynamic data revision number or reference.
- f. The source of the basic aerodynamic model and the aerodynamic coefficient data used to modify the basic model.
- g. The engine model(s) and its data revision number or reference.
- h. The flight control data revision number or reference.
- i. The flight management system identification and revision level.
- j. The FFS model and manufacturer.
- k. The date of FFS manufacture.
- l. The FFS computer identification.
- m. The visual system model and manufacturer, including display type.
- n. The motion system type and manufacturer, including degrees of freedom.
- o. A Table of Contents.
- p. A log of revisions and a list of effective pages.
- q. List of all relevant data references.
- r. A glossary of terms and symbols used (including sign conventions and units).
- s. Statements of compliance and capability (SOCs) with certain requirements.
- t. Recording procedures or equipment required to accomplish the objective tests.
- u. The following information for each objective test designated in Appendix A2, Table A2A (aeroplanes) Appendix B2, Table B2A (rotorcraft) as applicable to the qualification level sought:
 - 1) Name of the test.
 - 2) Objective of the test.
 - 3) Initial conditions.
 - 4) Manual test procedures.
 - 5) Automatic test procedures (if applicable).
 - 6) Method for evaluating FFS objective test results.
 - 7) List of all relevant parameters driven or constrained during the automatically conducted test(s).
 - 8) List of all relevant parameters driven or constrained during the manually conducted test(s).
 - 9) Tolerances for relevant parameters.
 - 10) Source of Validation Data (document and page number).

- 11) Copy of the Validation Data (if located in a separate binder, a cross reference for the identification and page number for pertinent data location must be provided).
- 12) Simulator Objective Test Results as obtained by the sponsor. Each test result must reflect the date completed and must be clearly labeled as a product of the device being tested.

4.14.6 For a convertible FFS, the NSEP will evaluate each converted model or series aircraft as a separate device and issue a separate TCID number and qualification for each. If a sponsor seeks qualification for two or more models of an aircraft type using a convertible FFS, the sponsor must submit a QTG for each aircraft model, or a QTG for the first aircraft model and a supplement to that QTG for each additional aircraft model. The MSP may schedule and administer the evaluations as separate events for each aircraft model depending on the complexity of the device.

4.14.7 The following describes the acceptable form and manner to present objective test results in the QTG:

- a. The sponsor's FFS test results must be recorded in a manner acceptable to the MSP, that allows easy comparison of the FFS test results to the validation data (e.g., use of a multi-channel recorder, line printer, cross plotting, overlays, transparencies).
- b. Test results must be labeled using terminology common to aircraft parameters as opposed to computer software identifications and tolerance parameters must be presented in the units used in Appendix A2, Table A2A for aeroplanes, or Appendix B2, Table B2A for rotorcrafts.
- c. Validation data documents included in a QTG may be photographically reduced only if such reduction will not alter the graphic scaling or cause difficulties in scale interpretation or resolution.
- d. Scaling on graphical presentations must provide the resolution necessary to evaluate the parameters shown in Appendix A2, Table A2A for aeroplanes, or Appendix B2, Table B2A for rotorcrafts.
- e. Tests involving time histories, data sheets (or transparencies thereof) and FFS test results must be clearly marked with appropriate reference points to ensure an accurate comparison between the FFS and the aircraft with respect to time. Time histories recorded via a line printer are to be clearly identified for cross plotting on the aircraft data. Over-plots must not obscure the reference data.

4.14.8 The sponsor may elect to complete the QTG objective and subjective tests at the manufacturer's facility or at the sponsor's training facility (or other sponsor designated location where training will take place). If the tests are conducted at the manufacturer's facility, the sponsor must repeat at least one-third of the tests at the sponsor's training facility in order to substantiate FFS performance. The QTG must be clearly annotated to indicate when and where each test was accomplished. Tests conducted at the manufacturer's facility and at the sponsor's training facility must be conducted after the FFS is assembled with systems and sub-systems functional and operating in an interactive manner. The test results must be submitted to the MSP.

4.14.9 The sponsor must maintain a copy of the MQTG at the FFS location.

4.14.10 During the initial (or upgrade) qualification evaluation conducted by the MSP, the sponsor must also provide a person who is a user of the device (e.g., a qualified pilot or instructor pilot with flight time experience in that aircraft) and knowledgeable about the operation of the aircraft and the operation of the FFS.

4.15 Alternative Data Sources, Procedures, and Instrumentation: Level A and Level B Simulators Only

- 4.15.1 Sponsors are not required to use the alternative data sources, procedures, and instrumentation; however, a sponsor may choose to use one or more of the alternative sources, procedures, and instrumentation described in Table A2B for Aeroplanes or Table B2B for Rotorcraft.
- Note:** There is no Level-A qualification level published in this manual for a Rotorcraft FFS.
- 4.15.2 It has become standard practice for experienced simulator manufacturers to use modeling techniques to establish data bases for new simulator configurations while awaiting the availability of actual flight test data. The data generated from the aerodynamic modeling techniques is then compared to the flight test data when it becomes available. The results of such comparisons have become increasingly consistent, indicating that these techniques, applied with the appropriate experience, are dependable and accurate for the development of aerodynamic models for use in Level A and Level B simulators. Based on this history of successful comparisons, the MSP has concluded that those who are experienced in the development of aerodynamic models may use modeling techniques as an alternative method for acquiring flight test data for Level A or Level B simulators.
- 4.15.3 The information in Tables A2B (Aeroplanes) and B2B (Rotorcraft) (Alternative Data Sources, Procedures, and Instrumentation) is presented to describe an acceptable alternative to data sources for simulator modeling and validation and an acceptable alternative to the procedures and instrumentation traditionally used to gather such modeling and validation data.
- Alternative data sources that may be used for part or all of a data requirement are the Aircraft Maintenance Manual, the Airplane Flight Manual (AFM), Rotorcraft Flight manual (RFM), Aircraft Design Data, the Type Inspection Report (TIR), Certification Data or acceptable supplemental flight test data.
 - The sponsor should coordinate with the MSP prior to using alternative data sources in a flight test or data gathering effort.
- 4.15.4 The use of these alternative data sources, procedures, and instrumentation is based on the following presumptions:
- For Aeroplanes FFS only: Data gathered through the alternative means does not require angle of attack (AOA) measurements or control surface position measurements for any flight test. However, AOA can be sufficiently derived if the flight test program ensures the collection of acceptable level, un-accelerated, trimmed flight data. All of the simulator time history tests that begin in level, un-accelerated, and trimmed flight, including the three basic trim tests and “fly-by” trims, can be a successful validation of angle of attack by comparison with flight test pitch angle. (Note: Due to the criticality of angle of attack in the development of the ground effects model, particularly critical for normal landings and landings involving cross-control input applicable to Level B simulators, stable “fly-by” trim data will be the acceptable norm for normal and cross-control input landing objective data for these applications.)
 - The use of a rigorously defined and fully mature simulation controls system model that includes accurate gearing and cable stretch characteristics (where applicable), determined from actual aircraft measurements. Such a model does not require control surface position measurements in the flight test objective data in these limited applications.
- 4.15.5 The sponsor is urged to contact the MSP for clarification of any issue regarding aeroplanes with reversible control systems. Tables A2B and B2B are not applicable to FFSs simulating Computer Controlled Aircraft.
- 4.15.6 Use of alternate data sources, procedures, and instrumentation described in Tables A2B and B2B does not relieve the sponsor from compliance with the balance of the information contained in this document relative to Level A or Level B FFSs.
- 4.15.7 When the term “inertial measurement system” is used in Tables A2B and B2B, it includes the use of a functional global positioning system (GPS).

- 4.15.8 Synchronized video for the use of alternative data sources, procedures, and instrumentation should have:
- a. Sufficient resolution to allow magnification of the display to make appropriate measurement and comparisons; and
 - b. Sufficient size and incremental marking to allow similar measurement and comparison. The detail provided by the video should provide sufficient clarity and accuracy to measure the necessary parameter(s) to at least 1/2 of the tolerance authorized for the specific test being conducted and allow an integration of the parameter(s) in question to obtain a rate of change.

4.16 Objective Test Requirements

- 4.16.1 The ground and flight tests required for qualification are listed in Appendix A2, Table of A2A for aeroplanes and Appendix B2, Table of B2A for rotorcraft, FFS Objective Tests. The sponsor may disregard those tests where stated flight or operating conditions do not apply to the simulated aircraft or qualification level (e.g., an engine out missed approach for a single-engine aircraft, or a hover test for a Level B rotorcraft simulator). Although use of a driver program designed to automatically accomplish the tests is encouraged for all simulators and required for Level C and Level D simulators, each test must be able to be accomplished manually while recording all appropriate parameters.
- 4.16.2 Computer-generated simulator test results are required for each test except where an alternative test is specifically authorized by the MSP. The results of each test must be:
- a. presented to allow a clear comparison against the validation data described in Chapter 2, Section 2.14 of this manual;
 - b. produced on an appropriate recording device acceptable to the MSP and must include simulator number, date, time, conditions, tolerances, and appropriate dependent variables portrayed in comparison to the validation data;
 - c. presented as time histories unless otherwise indicated in Table A2A or Table B2A as applicable; and
 - d. labeled using the tolerances and units given.
- 4.16.3 Table A2A, Table B2A set out the test results required, including the parameters, tolerances, and flight conditions for simulator validation. Tolerances are provided for the listed tests because mathematical modeling and acquisition/development of reference data are often inexact. All tolerances listed in the following tables are applied to simulator performance. When two tolerance values are given for a parameter, the less restrictive value may be used unless otherwise indicated. In those cases where a tolerance is expressed only as a percentage, the tolerance percentage applies to the maximum value of that parameter within its normal operating range as measured from the neutral or zero position unless otherwise indicated.
- 4.16.4 Certain tests included in Appendix A2 (aeroplanes) and Appendix B2 (rotorcraft) must be supported with a Statement of Compliance (SOC). Requirements for SOCs are indicated in Table A1A or Table B1A as applicable.
- 4.16.5 When operational or engineering judgment is used to assess test results against flight test validation data, such judgment must not be limited to a single parameter. When it is difficult or impossible to match simulator to aircraft data throughout a time history, differences must be justified using valid comparisons of other related parameters for the condition being assessed. For example, data that exhibit rapid variations of a specific measured parameter may require interpolations or a “best fit” data selection. To accept the “best fit” and support an overall interpretation of the test, all relevant parameters related to the maneuver or flight condition must be provided.

- 4.16.6 The FFS may not be programmed so that the mathematical modeling is correct only at the validation test points. Unless noted otherwise, simulator tests must represent aircraft performance and handling qualities at operating weights and centers of gravity (CG) typical of normal operation. If a test is supported by aircraft data at one extreme weight or CG, another test supported by aircraft data at mid-conditions or as close as possible to the other extreme must be included; however, if it can be shown that a test is relevant only at one extreme CG or weight condition, then it need not be repeated at the other extreme.
- 4.16.7 When comparing the parameters listed to those of the aircraft, sufficient data must also be provided to verify the correct flight condition and aircraft configuration changes. For example, to show that control force is within ± 0.5 pound (0.22 daN) in a static stability test, data to show the correct airspeed, power, thrust or torque, aircraft configuration, altitude, and other appropriate datum identification parameters that make affect the tolerance parameter must also be given. If comparing short period dynamics, normal acceleration may be used to establish a match to the aircraft, but airspeed, altitude, control input, aircraft configuration, and other appropriate data must also be given. All airspeed values must be properly annotated (e.g., indicated versus calibrated). In addition, the same variables must be used for comparison (e.g., compare inches to inches rather than inches to centimeters).
- 4.16.8 The QTG provided by the sponsor must clearly describe how the simulator will be set up and operated for each test. Each simulator subsystem may be tested independently; however, to assure that the total simulator system meets the prescribed standards, overall integrated testing of the system must also be accomplished. A manual test procedure with explicit and detailed steps for completing each test must also be provided.
- 4.16.9 The sponsor may request approval to use applicable tests and tolerances from this manual for a previously qualified simulator. The request must be made by submitting a proposed MQTG revision for MSP approval. Once approved, the revised tests may be used in subsequent continuing qualification evaluations.
- 4.16.10 Motion system tests will adhere to the following:
- a. The minimum excursions, accelerations, and velocities for pitch, roll, and yaw must be measurable about a single, common reference point and must be achieved by driving one degree of freedom at a time.
 - b. The minimum excursions, accelerations, and velocities for heave, sway, and surge may be measured about different, identifiable reference points and must be achieved by driving one degree of freedom at a time.
- 4.16.11 Aeroplane FFS Only – Objective tests for Computer Controlled Aircraft (CCA) simulators, or other highly augmented aeroplane simulators, will require flight test data for the Normal (N) and/or Non-normal (NN) control states, as indicated in Appendix A2. Where test results are independent of control state, Normal or Non-normal control data may be used. All tests in Table A2A require test results in the Normal control state unless specifically noted otherwise in the Test Details section following the CCA designation. The MSP will determine what tests are appropriate for aeroplane simulation data. When making this determination, the MSP may require other levels of control state degradation for specific aeroplane tests. Where Non-normal control states are required, test data must be provided for one or more Non-normal control states, and must include the least augmented state. Where applicable, flight test data must record Normal and Non-normal states for:
- 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.
- 4.16.12 Tests of handling qualities must include validation of augmentation devices. FFSs for highly augmented aircraft will be validated both in the augmented configuration and the unaugmented

configuration (or failure state with the maximum permitted degradation in handling qualities). The following guidelines apply:

- a. Where various levels of handling qualities result from failure states, validation of the effect of the failure is necessary.
- b. Unaugmented data are not required for those performance and static handling qualities tests if the design of the system precludes any effect on control position, and the control position is of primary concern in the test.
- c. In those instances where the unaugmented aircraft response is divergent and non-repeatable, it may not be feasible to meet the specified tolerances.
- d. Alternative requirements for testing will be mutually agreed upon by the sponsor and the MSP on a case-by-case basis.

- 4.16.13 Some tests will not be required for simulators using aircraft hardware in the simulator flight deck (e.g., “rotorcraft modular controller” or “aeroplane side stick controller”). These exceptions are noted in Appendix A2, Table A2A for aeroplanes and Appendix B2, Table B2A for rotorcraft. However, in these cases, the sponsor must provide a statement that the aircraft hardware meets the appropriate manufacturer’s specifications and the sponsor must have supporting information to that fact available for MSP review.
- 4.16.14 The terms “light”, “medium”, and “near maximum” gross weight are defined in Chapter 1 of this manual. These definitions may not be appropriate for the simulation of light-class rotorcrafts. In cases where light-class rotorcrafts are being simulated, prior coordination with the MSP on acceptable weight ranges is required.
- 4.16.15 In those cases where the QPS permits a “snapshot” or a “series of snapshot” tests results in lieu of a time-history, the sponsor or other data provider must ensure that a steady state condition exists from interval of 4 seconds before to 1 second after the time the “snapshot” was captured.
- 4.16.16 If relevant winds are present in the objective data, the wind vector should be clearly noted as part of the data presentation, expressed in conventional terminology, and related to the runway being used for tests near the ground.
- 4.16.17 The numbering system used for objective test results in the QTG should closely follow the numbering system set out in Appendix A2, Table A2A (aeroplanes) or Appendix B2, Table B2A (rotorcraft) as applicable.

4.17 Subjective Testing Discussion

- 4.17.1 The subjective tests provide a means evaluate the simulator’s stability and performance over a typical training session. The tests are based on performing specific tasks to verify the correct operation of simulator controls, instruments, and systems and to determine whether the device accurately simulates required maneuvers, procedures, or tasks. These tasks are listed in the following Tables are intended for simulator evaluation purposes only. They may not be used to limit or exceed the authorizations for use of a given level of simulator, as described on the SOQ, or as approved by the TPAA:
- a. **Tables A3A (Aeroplanes) and B3A (Rotorcraft) - Operations Tasks** are used to organize and test the pilot’s functional interaction with the simulator. These tasks are divided into phases of flight and include maneuvers and procedures called flight tasks. While performing these tasks, the evaluator will also examine the sensory cueing from the motion system, visual system, and special effects in an operational context. There are flight tasks included to address some features of advanced technology aircrafts and innovative training programs. For example, “high angle-of-attack maneuvering” is included to provide a required alternative to “approach to stalls” for aircrafts employing flight envelope protection functions.

- b. **Tables A3G and B3G, Instructor Operating Station** are tests that address the overall function and control of the simulator including the various simulated environmental conditions; simulated aircraft system operations (normal, abnormal, and emergency); visual system displays; and special effects necessary to meet flight crew training, evaluation, or flight experience requirements.

- 4.17.2 All simulated aircraft-system functions will be assessed for normal and, where appropriate, alternate operations. Normal, abnormal, and emergency operations associated with a flight phase will be assessed during the evaluation of flight tasks or events within that flight phase. Simulated aircraft systems are listed separately under “Any Flight Phase” to ensure appropriate attention to systems checks. Operational navigation systems (including inertial navigation systems, global positioning systems, or other long-range systems) and their associated electronic display systems will be evaluated if installed. The NSEP evaluation report will identify any operational discrepancies or system limitations observed during the evaluation.
- 4.17.3 Simulators demonstrating a satisfactory circling approach during the initial will be qualified for the circling approach maneuvers. The Sponsor must present a Class I or II scene with a circling approach to support the evaluation. To be considered satisfactory, the circling approach will be flown at maximum gross weight for landing, with minimum visibility for the aircraft approach category, and must allow proper alignment with a landing runway at least 90° different from the instrument approach course while allowing the pilot to keep an identifiable portion of the airport in sight throughout the maneuver. Once FSTD is qualified, the TPAA may approve the use of this approach in the sponsor's Transport Canada-approved flight training program. Additional circling approaches may be approved by a type-qualified Transport Canada Civil Aviation Inspector or Approved Check Pilot (ACP) by following the procedures and guidance found in Chapter 7, Section 7.8 of this manual.
- 4.17.4 At the request of the TPAA, the MSP may assess a device to determine if it is capable of simulating certain training tasks in a sponsor's training program that are not included in appendices A3 or B3. Unless directly related to a requirement for the qualification level, the results of such an evaluation would not affect the qualification level of the simulator. However, if the MSP determines that the simulator does not accurately simulate that training activity, the simulator would not be approved for that training activity.
- 4.17.5 The TPAA may allow the use of Class III airport models if the sponsor provides an appropriate analysis of the skills, knowledge, and proficiency necessary for competent performance of the tasks in which this particular model is used. The analysis should identify the specific airport model and describe the ability of the FFS/visual media to support the skill, knowledge and proficiency objectives of the particular training tasks in which it is used. The analysis should also specify the training conditions and script scenarios for training and checking and identify any limitations that may affect the training.

4.18 Conduct of Initial and Upgrade Evaluations

- 4.18.1 The MSP may only accept initial evaluation requests from eligible sponsors as defined in Chapter 2, Section 2.6 of this manual. However, other FFS evaluations may be conducted on a case-by-case as the Minister deems appropriate in accordance with pre-arranged conditions and agreements.
- 4.18.2 The MSP will conduct an evaluation as completely as possible for each FFS configuration. Each initial or upgrade evaluation will be based on assessing compliance to the general simulator requirements in Appendix A1 or B1, the objective tests listed in Appendix A2 (aeroplanes) or B2 (rotorcraft), and the subjective tests listed in Appendix A2 (aeroplanes) or B2 (rotorcraft), as applicable. The evaluations described herein will include, but not necessarily be limited to the following:

- a. Aircraft responses, including longitudinal and lateral-directional control responses (see Appendix A2 (aeroplanes) or B2 (rotorcraft) as applicable);
- b. Performance in authorized portions of the simulated aircraft's operating envelope, to include tasks evaluated by the MSP in the areas of surface operations, takeoff, climb, cruise, descent, approach, and landing as well as abnormal and emergency operations (see Appendix A2 (aeroplanes) or B2 (rotorcraft));
- c. Control checks (see Appendix A1 and A2 (aeroplanes) or Appendix B1 and B2 (rotorcraft) as applicable);
- d. Flight deck configuration (see Appendix A1 (aeroplanes) or B1 (rotorcraft) as applicable);
- e. Pilot, flight engineer, and instructor station functions checks (see Appendix A1 and A3 (aeroplanes) or Appendix B1 and B3 (rotorcraft) as applicable);
- f. Aircraft systems and sub-systems (as appropriate) as compared to the aircraft simulated (see Appendix A1 and A3 (aeroplanes) or Appendix B1 and B3 (rotorcraft) as applicable);
- g. FFS systems and sub-systems, including force cueing (motion), visual, and aural (sound) systems, as appropriate (see Appendix A1 and A2 (aeroplanes) or Appendix B1 and B2 (rotorcraft) as applicable); and
- h. Certain additional requirements, depending upon the qualification level sought, including equipment or circumstances that may become hazardous to the occupants. The sponsor may be subject to Occupational Safety and Health Administration requirements.

4.18.3 The MSP administers the objective and subjective tests, which will includes an examination of system functions. The tests will include a qualitative assessment by a Transport Canada pilot. The NSEP evaluation team leader may assign other qualified personnel to assist in accomplishing the functions examination and/or the objective and subjective tests performed during an evaluation when required.

- a. Objective tests provide a basis for measuring and evaluating FFS performance and determining compliance with the requirements of this part.
- b. Subjective tests provide a basis for:
 - 1) Evaluating the capability of the FFS to perform over a typical utilization period;
 - 2) Determining that the FFS satisfactorily simulates each required task;
 - 3) Verifying correct operation of the FFS controls, instruments, and systems; and
 - 4) Demonstrating compliance with the requirements of this manual.

Note: Guidance for planning a functions and subjective test can be found at Attachment 4.2 of this chapter.

4.18.4 The tolerances for the test parameters listed in Appendix A2 (aeroplanes) and B2 (rotorcraft) reflect the range of tolerances acceptable to the MSP for FFS validation and are not to be confused with design tolerances specified for FFS manufacture. In making decisions regarding tests and test results, the MSP relies on the use of operational and engineering judgment in the application of data (including consideration of the way in which the flight test was flown and the way the data was gathered and applied), data presentations, and the applicable tolerances for each test.

4.18.5 Problems with objective test results are handled as follows:

- a. If the NSEP evaluation team detects a problem with an objective test procedure, content or presentation during an evaluation, the test may be repeated or the discrepancy may be resolved by amending the QTG.
- b. If it is determined that the results of an objective test do not support the level requested but do support a lower level, the MSP may qualify the FFS at that lower level. For example, if a Level

D evaluation is requested and the FFS fails to meet sound test tolerances, it could be qualified at Level C.

- 4.18.6 After an FFS is successfully evaluated, the MSP will issues a FSTD Qualification Certificate to the sponsor. The certificate will include a “qualification profile” that identifies the FFS software and appliances evaluated, and any additional tasks or deviations from the referenced tasks lists described in Appendix A1, Table A1B (aeroplanes) or Appendix B1, Table B1B (rotorcraft) as applicable. Once qualified, the FFS is eligible for use in a Transport Canada approved flight training program. The TPAA is the responsible authority that approves the use of an FSTD in a flight training program. It remains the sponsor’s responsibility to ensure TPAA approval for each air operator or private operator using the FFS in a Transport Canada approved training program.
- 4.18.7 Under normal circumstances, the MSP will tentatively schedule a date for the initial or upgrade evaluation within fifteen (15) working days after receiving the sponsor’s request (letter of intent) and confirm the evaluation date when the complete QTG is acceptable. Sponsor application procedures for initial evaluations are found in Section 3.3 of the manual.

4.19 Continuing Qualification Evaluations and Requirements

- 4.19.1 The MSP will conduct continuing qualification evaluations in accordance with the requirements of CAR 606.03 unless the MSP becomes aware of discrepancies or performance problems with the device that warrants more frequent evaluations.
- 4.19.2 To support continuing qualification, the sponsor is responsible for:
- conducting a minimum of four evenly spaced inspections throughout the year. The objective test sequence and content of each inspection must be developed by the sponsor and must be acceptable to the MSP.
 - maintaining a description of the functional pre-flight check in their maintenance procedures’
 - recording all “functional pre-flights” in the FFS discrepancy log book or other acceptable location, and
 - maintaining a current record of any item found to be missing, malfunctioning, or inoperative.
- 4.19.3 The sponsor’s test sequence and the content of each quarterly inspection required in chapter 2, paragraph 2.8.1 a) of this manual should include a balance and a mix from the objective test requirement areas listed as follows:
- Performance.
 - Handling qualities.
 - Motion system (where appropriate).
 - Visual system (where appropriate).
 - Sound system (where appropriate).
 - Other FFS systems.
- 4.19.4 The sponsor must provide a person knowledgeable about the operation of the aircraft and the operation of the FFS to support a continuing qualification evaluation conducted by the MSP.
- 4.19.5 If the NSEP evaluator plans to accomplish specific tests during a normal continuing qualification evaluation that requires the use of special equipment or technicians, the sponsor will be notified as far in advance of the evaluation as practical; but not less than 72 hours. Examples of such tests include latencies, control dynamics, sounds and vibrations, motion, and/or some visual system tests.
- 4.19.6 The continuing qualification evaluations, described in Chapter 3, paragraph 3.8.3 of this manual will normally require 6 hours of FFS time. However, flexibility is necessary to address abnormal

situations or situations involving aircraft with additional levels of complexity (e.g., computer controlled aircraft). The sponsor should anticipate that some tests may require additional time. The continuing qualification evaluations will consist of the following:

- a. Review of the results of the quarterly inspections conducted by the sponsor since the last scheduled continuing qualification evaluation.
- b. Review MQTG document control and relevant discrepancy history.
- c. A selection of approximately 8 to 15 objective tests from the MQTG that provide an adequate opportunity to evaluate the performance of the FFS. The tests chosen will be performed either automatically or manually and should be able to be conducted within approximately one-third of the allotted FFS time.
- d. A subjective evaluation of the FFS to perform a representative sampling of the tasks set out in Appendix A3 (aeroplanes) or Appendix B3 (rotorcraft) as applicable. This portion of the evaluation should take approximately two-thirds of the allotted FFS time.
- e. An examination of the functions of the FFS may include the motion system, visual system, sound system, instructor operating station, and the normal functions and simulated malfunctions of the aeroplane systems. This examination is normally accomplished simultaneously with the subjective evaluation requirements.

Note: Guidance for planning a functions and subjective test can be found at Attachment 4.2 of this chapter.

- 4.19.7 In addition to the scheduled continuing qualification evaluation, each FFS is subject to evaluations conducted by the MSP at any time without prior notification to the sponsor. Such evaluations would be accomplished in a normal manner (i.e., requiring exclusive use of the FFS for the conduct of objective and subjective tests and an examination of functions) if the FFS is not being used for pilot training and checking. However, if the FFS were being used, the evaluation would be conducted in a non-exclusive manner. This non-exclusive evaluation will be conducted by the FFS evaluator accompanying the ACP, instructor, or Transport Canada inspector aboard the FFS along with the student(s) and observing the operation of the FFS during the training, testing, or checking activities.

Appendix A1 - Aeroplane FFS – General Simulator Requirements

1. This Appendix describes the general simulator requirements for qualifying an aeroplane FFS. The sponsor should also consult the objective tests in Appendix A2 and functions and subjective tests listed in Appendix A3 of this to determine the complete requirements for an aeroplane specific level simulator.
2. The material contained in this Appendix is divided into the following categories:
 - a. General flight deck configuration.
 - b. Simulator programming.
 - c. Equipment operation.
 - d. Equipment and facilities for instructor/evaluator functions.
 - e. Motion system.
 - f. Visual system.
 - g. Sound system.
3. Table A1A provides the standards for the General Simulator Requirements.
4. Table A1B provides the tasks that the sponsor should verify before the evaluation to determine whether the FFS satisfactorily meets the requirements for flight crew training, and checking. It also provides the tasks that for the basis for the qualification profile on the FSTD Qualification Certificate.
5. Table A1C provides the functions that an instructor/check pilot must be able to control in the simulator.
6. The sponsor's letter of compliance to the MSP prior to an initial evaluation will attest that all applicable and relevant tests have been accomplished and the FFS is ready for an evaluation. During the initial or recurrent evaluations, it is not required that all of the tasks appearing on the qualification profile be accomplished.

Table A1A – Aeroplane - Minimum Simulator Requirements

Table A1A – Aeroplane - Minimum Simulator Requirements						
Entry No.	General Simulator Requirements	Simulator Level				Notes
		A	B	C	D	
1. GENERAL FLIGHT DECK CONFIGURATION						
1.a.	The simulator must have a flight deck that is a replica of the aeroplane simulated with controls, equipment, observable flight deck indicators, circuit breakers, and bulkheads properly located, functionally accurate and replicating the aeroplane. The direction of movement of controls and switches must be identical to the aeroplane. Pilot seats must allow the occupant to achieve the design “eye position” established for the aeroplane being simulated. Equipment for the operation of the flight deck windows must be included, but the actual windows need not be operable. Additional equipment such as fire axes, extinguishers, and spare light bulbs must be available in the FFS but may be relocated to a suitable location as near as practical to the original position. Fire axes, landing gear pins, and any similar purpose instruments need only be represented in silhouette. The use of electronically displayed images with physical overlay or masking for simulator instruments and/or instrument panels is acceptable provided: (1) All instruments and instrument panel layouts are dimensionally correct with differences, if any, being imperceptible to the pilot; (2) Instruments replicate those of the aeroplane including full instrument functionality and embedded logic; (3) Instruments displayed are free of quantization (stepping); (4) Instrument display characteristics replicate those of the aeroplane including: resolution, colors, luminance, brightness, fonts, fill patterns, line styles and symbology; (5) Overlay or masking, including bezels and bugs, as applicable, replicates the aeroplane panel(s); (6) Instrument controls and switches replicate and operate with the same technique, effort, travel and in the same direction as those in the aeroplane; (7) 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; and (8) As applicable, instruments must have faceplates that replicate those in the aeroplane; and	X	X	X	X	For simulator purposes, the flight deck consists of all that space forward of a cross section of the flight deck at the most extreme aft setting of the pilots' seats, including additional required crewmember duty stations and those required bulkheads aft of the pilot seats. For clarification, bulkheads containing only items such as landing gear pin storage compartments, fire axes and extinguishers, spare light bulbs, and aircraft document pouches are not considered essential and may be omitted.
1.a.	Level C and Level D only; (1) 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 the principle operator's 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. Viewing angle error and parallax must be minimized on shared instruments such and engine displays and standby indicators.			X	X	
1.b.	Those circuit breakers that affect procedures or result in observable flight deck indications must be properly located and functionally accurate.	X	X	X	X	

Table A1A – Aeroplane - Minimum Simulator Requirements							
Entry No.	General Simulator Requirements	Simulator Level				Notes	
		A	B	C	D		
2. PROGRAMMING							
2.a	A light dynamics model that accounts for various combinations of drag and thrust normally encountered in flight must correspond to actual flight conditions, including the effect of change in aeroplane attitude, thrust, drag, altitude, temperature, gross weight, moments of inertia, center of gravity location, and configuration. An SOC is required.	X	X	X	X	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 data at a minimum should contain 3 weight conditions including zero fuel weight and maximum taxi weight with a least 2 different combinations of zero fuel weight, fuel weight and payload for each condition.	
2.a	For Level C and Level D simulators, the effects of pitch attitude and of fuel slosh on the aircraft center of gravity must be simulated. An SOC is required.			X	X		
2.b	The simulator must have the computer capacity, accuracy, resolution, and dynamic response needed to meet the qualification level sought. An SOC is required.	X	X	X	X		
2.c	Surface operations must be represented to the extent that allows turns within the confines of the runway and adequate controls on the landing and roll-out from a crosswind approach to a landing.	X					
2.d.	Ground handling and aerodynamic programming must include the following:						
2.d.1	Ground effect.			X	X	Ground effect includes modeling that accounts for round-out, flare, touchdown, lift, drag, pitching moment, trim, and power while in ground effect.	
2.d.2	Ground reaction. Ground reaction modeling must produce the appropriate effects during bounced or skipped landings, including the effects and indications of ground contact due to landing in an abnormal aircraft attitude (e.g. tail strike or nosewheel contact). An SOC is required.		X	X	X	Ground reaction includes modeling that accounts for strut deflections, tire friction, and side forces. This is the reaction of the aeroplane upon contact with the runway during landing, and may differ with changes in factors such as gross weight, airspeed, or rate of descent on touchdown.	

Table A1A – Aeroplane - Minimum Simulator Requirements							
Entry No.	General Simulator Requirements	Simulator Level				Notes	
		A	B	C	D		
2.d.3	Ground handling characteristics, including aerodynamic and ground reaction modeling including steering inputs, operations with crosswind, braking, thrust reversing, deceleration, and turning radius. An SOC is required		X	X	X	In developing gust models for use in training, the FSTD sponsor should coordinate with the data provider to ensure that the gust models do not exceed the capabilities of the aerodynamic and ground models.	
	Aerodynamic and ground reaction modeling to support training in crosswinds and gusting crosswinds up to the aircraft's maximum demonstrated crosswind component. Realistic gusting crosswind profiles must be available to the instructors that have been tuned in intensity and variation to require pilot intervention to avoid runway departure during takeoff or landing roll. An SOC is required			X	X		
2.e.	If the aircraft being simulated is required to have a Low-altitude windshear system installed to meet Transport Canada type-certification requirements, the simulator must employ windshear models that provide training for recognition of windshear phenomena and the execution of recovery procedures. Models must be available to the instructor/evaluator for the following critical phases of flight: (1) Prior to takeoff rotation; (2) At liftoff; (3) During initial climb; and (4) On final approach, below 500 ft. AGL. The QTG must reference the FAA Windshear 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 Aerospace Establishment (RAE), the Joint Airport Weather Studies (JAWS) Project and other recognized sources may be implemented, but must be supported and properly referenced in the QTG. Only those simulators meeting these requirements may be used to satisfy the CAR training requirements pertaining to a certificate holder's approved low-altitude windshear flight training program. The addition of realistic levels of turbulence associated with each required windshear profile must be available and selectable to the instructor. In addition to the four basic windshear models required for qualification, at least two additional "complex" windshear models must be available to the instructor which represent the complexity of actual windshear encounters. These models must be available in the takeoff and landing configurations and must consist of independent variable winds in multiple simultaneous components. The Windshear Training Aid provides two such example "complex" windshear models that may be used to satisfy this requirement.			X	X	If desired, Level A and B simulators may qualify for windshear training by meeting these standards; see Chapter 6, Section 6.2. Windshear models may consist of independent variable winds in multiple simultaneous components. The FAA Windshear Training Aid presents one acceptable means of compliance with simulator wind model requirements. The simulator should employ a method to ensure the required survivable and non-survivable windshear scenarios are repeatable in the training environment.	
2.f.	The simulator must provide for manual and automatic testing of simulator hardware and software programming to determine compliance with simulator objective tests as prescribed in Appendix A2. An SOC is required.			X	X	Automatic "flagging" of out-of-tolerance situations is encouraged.	

Table A1A – Aeroplane - Minimum Simulator Requirements						
Entry No.	General Simulator Requirements	Simulator Level				Notes
		A	B	C	D	
2.g.	Relative responses of the motion system, visual system, and flight deck instruments, measured by latency tests or transport delay tests. Motion onset should occur before the start of the visual scene change (the start of the scan of the first video field containing different information) but must occur before the end of the scan of that video field. Instrument response may not occur prior to motion onset. Test results must be within the following limits:					The intent is to verify that the simulator provides instrument, motion, and visual cues that are, within the stated time delays, like the aeroplane responses. For aeroplane response, acceleration in the appropriate, corresponding rotational axis is preferred.
2.g.1	300 milliseconds of the aeroplane response.	X	X			
2.g.2	100 milliseconds of the aeroplane response (motion and instrument cues) 120 milliseconds of the aeroplane response (visual system cues)			X	X	
2.h.	The simulator must accurately reproduce the following runway conditions : (1) Dry; (2) Wet; (3) Icy; (4) Patchy Wet; (5) Patchy Icy; and (6) Wet on Rubber Residue in Touchdown Zone; An SOC is required.			X	X	
2.i.	The simulator must simulate: (1) Brake and tire failure dynamics, including antiskid failure; and (2) Decreased brake efficiency due to high brake temperatures, if applicable. An SOC is required			X	X	Simulator pitch, side loading, and directional control characteristics should be representative of the aeroplane.
2.j.	Engine and Airframe Icing Modeling that includes the effects of icing, where appropriate, on the airframe, aerodynamics, and the engine(s). Icing models must 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. Aircraft systems (such as the stall protection system and auto-flight system) must respond properly to ice accretion consistent with the simulated aircraft. Aircraft OEM data or other acceptable analytical methods must be utilized to develop ice accretion models. Acceptable analytical methods may include wind tunnel analysis and/or engineering analysis of the aerodynamic effects of icing on the lifting surfaces coupled with tuning and supplemental subjective assessment by a subject matter expert pilot. SOC and tests required. See objective testing requirements (Appendix 4A2, test 2.i.).			X	X	SOC should be provided describing the effects which provide training in the specific skills required for recognition of icing phenomena and execution of recovery. The SOC should describe the source data and any analytical methods used to develop ice accretion models including verification that these effects have been tested. Icing effects simulation models are only required for those aeroplanes authorized for operations in icing conditions. See Chapter 6, Appendix E for further guidance material.

Table A1A – Aeroplane - Minimum Simulator Requirements

Entry No.	General Simulator Requirements	Simulator Level				Notes
		A	B	C	D	
2.k.	The aerodynamic modeling in the simulator must include: (1) Low-altitude level-flight ground effect; (2) Mach effect at high altitude; (3) Normal and reverse dynamic thrust effect on control surfaces; (4) Aeroelastic representations; and (5) Nonlinearities due to sideslip. An SOC is required and must include references to computations of aeroelastic representations and of nonlinearities due to sideslip.				X	See Section 4.8 of this Chapter for further information on ground effect.
2.l.	The simulator must have aerodynamic and ground reaction modeling for the effects of reverse thrust on directional control, if applicable. An SOC is required.		X	X	X	
2.m.	High Angle of Attack Modeling Aerodynamic stall modeling that includes degradation in static/dynamic lateral-directional stability, degradation in control response (pitch, roll, and 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 aerodynamic model must incorporate an angle of attack and sideslip range to support the training tasks. At a minimum, the model must support an angle of attack range to ten degrees beyond the stall identification angle of attack. The stall identification angle of attack is defined as the point where the behavior of the aeroplane gives the pilot a clear and distinctive indication through the inherent flight characteristics or the characteristics resulting from the operation of a stall identification device (e.g., a stick pusher) that the aeroplane has stalled. The model must be capable of capturing the variations seen in the stall characteristics of the aeroplane (e.g., the presence or absence of a pitch break, deterrent buffet, or other indications of a stall where present on the aircraft). The aerodynamic modeling must support stall training maneuvers in the following flight conditions: (1) Stall entry at wings level (1g); (2) Stall entry in turning flight of at least 25° bank angle (accelerated stall); (3) Stall entry in a power-on condition (required only for propeller driven aircraft); and (4) Aircraft configurations of second segment climb, high altitude cruise (near performance limited condition), and approach or landing. A Statement of Compliance (SOC) is required which describes the aerodynamic modeling methods, validation, and checkout of the stall characteristics of the FSTD. The SOC must also include verification that the FSTD has been evaluated by a subject matter expert pilot acceptable to the FAA. See Chapter 6, Appendix E for detailed requirements.				X	The requirements in this section only apply to those FSTDs that are qualified for full stall training tasks. Sponsors may elect to not qualify an FSTD for full stall training tasks; however, the FSTD's qualification will be restricted to approach to stall training tasks that terminate at the activation of the stall warning system. Specific guidance should be available to the instructor which clearly communicates the flight configurations and stall maneuvers that have been evaluated in the FSTD for use in training. See Chapter 6, Appendix E for additional guidance material.

Table A1A – Aeroplane - Minimum Simulator Requirements							
Entry No.	General Simulator Requirements	Simulator Level				Notes	
		A	B	C	D		
3.a	All relevant instrument indications involved in the simulation of the aeroplane must automatically respond to control movement or external disturbances to the simulated aeroplane; e.g., turbulence or windshear. Numerical values must be presented in the appropriate units. For Level C and Level D simulators, instrument indications must also respond to effects resulting from icing.	X	X	X	X		
3.b	Communications, navigation, caution, and warning equipment must be installed and operate within the tolerances applicable for the aeroplane. Instructor control of internal and external navigational aids. Navigation aids must be usable within range or line-of-sight without restriction, as applicable to the geographic area.	X	X	X	X		
3.b.1	Complete navigation database for at least 3 airports with corresponding precision and non-precision approach procedures, including navigational database updates.			X	X		
3.b.2	Complete navigation database for at least 1 airport with corresponding precision and non-precision approach procedures, including navigational database updates.	X	X				
3.c	Simulated aeroplane systems must operate as the aeroplane systems operate under normal, abnormal, and emergency operating conditions on the ground and in flight. Once activated, proper systems operation must result from system management by the crew member and not require any further input from the instructor's controls.	X	X	X	X	Aeroplane system operation should be predicated on, and traceable to, the system data supplied by the aeroplane manufacturer, original equipment manufacturer or alternative approved data for the aeroplane system or component. At a minimum, alternate approved data should validate the operation of all normal, abnormal, and emergency operating procedures and training tasks the FSTD is qualified to conduct.	
3.d.	The simulator must provide pilot controls with control forces and control travel that correspond to the simulated aeroplane. The simulator must also react in the same manner as in the aeroplane under the same flight conditions. Control systems must 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 must be replicated.	X	X	X	X		
3.e.	Simulator control feel dynamics must replicate the aeroplane. This must be determined by comparing a recording of the control feel dynamics of the simulator to aeroplane measurements. For initial and upgrade qualification evaluations, the control dynamic characteristics must be measured and recorded directly from the flight deck controls, and must be accomplished in takeoff, cruise, and landing flight conditions and configurations.			X	X		

Table A1A – Aeroplane - Minimum Simulator Requirements							
Entry No.	General Simulator Requirements	Simulator Level				Notes	
		A	B	C	D		
3.f.	For aircraft equipped with a stick pusher system, control forces, displacement, and surface position must correspond to that of the aeroplane being simulated. A Statement of Compliance (SOC) is required verifying that the stick pusher system has been modeled, programmed, and validated using the aircraft manufacturer's design data or other acceptable data source. The SOC must address, at a minimum, stick pusher activation and cancellation logic as well as system dynamics, control displacement and forces as a result of the stick pusher activation. Tests required.			X	X	See Appendix A2, Table A2A, test 2.a.10 (stick pusher system force calibration) for objective testing requirements. The requirements in this section only apply to those FSTDs that are qualified for full stall training tasks.	
4. INSTRUCTOR OR EVALUATION FACILITIES.							
4. a.	In addition to the flight crewmember stations, the simulator must have at least two suitable seats for the instructor/ACP and Transport Canada inspector. These seats must provide adequate vision to the pilot's panel and forward windows. All seats other than flight crew seats need not represent those found in the aeroplane, but must be adequately secured to the floor and equipped with similar positive restraint devices.	X	X	X	X	The MSP will consider alternatives to this standard for additional seats based on unique flight deck configurations.	
4.b.	The simulator must have controls that enable the instructor/evaluator to control all required system variables and insert all abnormal or emergency conditions into the simulated aeroplane systems as described in the sponsor's Transport Canada-approved training program; or as described in the relevant operating manual as appropriate.	X	X	X	X		
4.c.	The simulator must have instructor controls for all environmental effects expected to be available at the IOS; e.g., clouds, visibility, icing, precipitation, temperature, storm cells and microbursts, turbulence, and intermediate and high altitude wind speed and direction.	X	X	X	X	Wind gradient, temperature gradient, and turbulence settings must be defaulted to represent nominal environmental changes with altitude based on instructor/evaluator surface condition set on the IOS.	
4.d.	The simulator must provide the instructor or evaluator the ability to present ground and air hazards.			X	X	For example, another aeroplane crossing the active runway or converging airborne traffic.	
5. MOTION SYSTEM.							
5.a.	The simulator must have motion (force) cues perceptible to the pilot that are representative of the motion in an aeroplane.	X	X	X	X	For example, touchdown cues should be a function of the rate	

Table A1A – Aeroplane - Minimum Simulator Requirements							
Entry No.	General Simulator Requirements	Simulator Level				Notes	
		A	B	C	D		
5.b.	The simulator must have a motion (force cueing) system with a minimum of three degrees of freedom (at least pitch, roll, and heave). An SOC is required.	X	X				
5.c.	The simulator must have a motion (force cueing) system that produces cues at least equivalent to those of a six-degrees-of-freedom, synergistic platform motion system (i.e., pitch, roll, yaw, heave, sway, and surge). An SOC is required.			X	X		
5.d.	The simulator must provide for the recording of the motion system response time. An SOC is required.	X	X	X	X		
5.e.	The simulator must provide motion effects programming to include:						
5.e.1	(1) Thrust effect with brakes set; (2) Runway rumble, oleo deflections, effects of ground speed, uneven runway, centerline lights, and taxiway characteristics; (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) Approach-to-stall buffet and stall buffet (where applicable); (8) Representative touchdown cues for main and nose gear; (9) Nosewheel scuffing, if applicable; (10) Mach and maneuver buffet; (11) Engine failures, malfunctions, and engine damage (12) Tail and pod strike;		X	X	X		
5.e.2	(13) Taxiing effects such as lateral and directional cues resulting from steering and braking inputs; (14) Buffet due to atmospheric disturbances (e.g. buffets due to turbulence, gusting winds, storm cells, windshear, etc.) in three linear axes (isotropic); (15) Tire failure dynamics; and (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.			X	X		
5.f	The simulator must provide characteristic motion vibrations that result from operation of the aeroplane if the vibration marks an event or aeroplane state that can be sensed in the flight deck.				X		The simulator should be programmed and instrumented in such a manner that the characteristic buffet modes can be measured and compared to aeroplane data.
6. VISUAL SYSTEM.							
6.a.	The simulator must have a visual system providing an out-of-the-flight deck view.	X	X	X	X		

Table A1A – Aeroplane - Minimum Simulator Requirements							
Entry No.	General Simulator Requirements	Simulator Level				Notes	
		A	B	C	D		
6.b.	The simulator must provide a continuous collimated field-of-view of at least 45° horizontally and 30° vertically per pilot seat or the number of degrees necessary to meet the visual ground segment requirement, whichever is greater. Both pilot seat visual systems must be operable simultaneously. The minimum horizontal field-of-view coverage must be plus and minus one-half (½) of the minimum continuous field-of-view requirement, centered on the zero degree azimuth line relative to the aircraft fuselage. An SOC is required and must explain the system geometry measurements including system linearity and field-of-view.	X	X			Additional field-of-view capability may be added at the sponsor's discretion provided the minimum fields of view are retained.	
6.c.	(Reserved)						
6.d.	The simulator must provide a continuous collimated visual field-of-view of at least 176° horizontally and 36° vertically or the number of degrees necessary to meet the visual ground segment requirement, whichever is greater. The minimum horizontal field-of-view coverage must be plus and minus one-half (½) of the minimum continuous field-of-view requirement, centered on the zero degree azimuth line relative to the aircraft fuselage. An SOC is required and must explain the system geometry measurements including system linearity and field-of-view.			X	X	The horizontal field-of-view is traditionally described as a 180° field-of-view. However, the field-of-view is technically no less than 176°. Additional field-of-view capability may be added at the sponsor's discretion provided the minimum fields of view are retained.	
6.e.	The visual system must be free from optical discontinuities and artifacts that create non-realistic cues.	X	X	X	X	Non-realistic cues might include image "swimming" and image "roll-off," that may lead a pilot to make incorrect assessments of speed, acceleration, or situational awareness.	
6.f.	The simulator must have operational landing lights for night scenes. Where used, dusk (or twilight) scenes require operational landing lights.	X	X	X	X		
6.g.	The simulator must have instructor controls for the following: (1) Visibility in statute miles (km) and runway visual range (RVR) in ft.(m); (2) Airport selection; and (3) Airport lighting.	X	X	X	X		
6.h.	The simulator must provide visual system compatibility with dynamic response programming.	X	X	X	X		
6.i.	The simulator must show that the segment of the ground visible from the simulator flight deck is the same as from the aeroplane flight deck (within established tolerances) when at the correct airspeed, in the landing configuration, at the appropriate height above the touchdown zone, and with appropriate visibility.	X	X	X	X	This will show the modeling accuracy of RVR, glideslope, and localizer for a given weight, configuration, and speed within the aeroplane's operational envelope for a normal approach and landing.	

Table A1A – Aeroplane - Minimum Simulator Requirements							
Entry No.	General Simulator Requirements	Simulator Level				Notes	
		A	B	C	D		
6.j.	The simulator must provide visual cues necessary to assess sink rates (provide depth perception) during takeoffs and landings, to include: (1) Surface on runways, taxiways, and ramps; and (2) Terrain features.		X	X	X		
6.k.	The simulator must provide for accurate portrayal of the visual environment relating to the simulator attitude.	X	X	X	X	Visual attitude vs. simulator 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.	
6.l.	The simulator must provide for quick confirmation of visual system color, RVR, focus, and intensity. An SOC is required.			X	X		
6.m.	The simulator must be capable of producing at least 10 levels of occulting.			X	X		
6.n.	Night Visual Scenes. When used in training, testing, or checking activities, the simulator must provide night visual scenes with sufficient scene content to recognize the airport, the terrain, and major landmarks around the airport. The scene content must allow a pilot to successfully accomplish a visual landing. Scenes must include a definable horizon and typical terrain characteristics such as fields, roads and bodies of water and surfaces illuminated by aeroplane landing lights.	X	X	X	X		
6.o.	Dusk (or Twilight) Visual Scenes. When used in training, testing, or checking activities, the simulator must provide dusk (or twilight) visual scenes with sufficient scene content to recognize the airport, the terrain, and major landmarks around the airport. The scene content must allow a pilot to successfully accomplish a visual landing. Dusk (or twilight) scenes, as a minimum, must provide full color presentations of reduced ambient intensity, sufficient surfaces with appropriate textural cues that include self-illuminated objects such as road networks, ramp lighting and airport signage, to conduct a visual approach, landing and airport movement (taxi). Scenes must include a definable horizon and typical terrain characteristics such as fields, roads and bodies of water and surfaces illuminated by aeroplane landing lights. If provided, directional horizon lighting must have correct orientation and be consistent with surface shading effects. Total night or dusk (twilight) scene content must be comparable in detail to that produced by 10,000 visible textured surfaces and 15,000 visible lights with sufficient system capacity to display 16 simultaneously moving objects. An SOC is required.			X	X		
6.p.	Daylight Visual Scenes. The simulator must provide daylight visual scenes with sufficient scene content to recognize the airport, the terrain, and major landmarks around the airport. The scene content must allow a pilot to successfully accomplish a visual landing. Any ambient lighting must not “washout” the displayed visual scene. Total daylight scene content must be comparable in detail to that produced by 10,000 visible textured surfaces and 6,000 visible lights with sufficient system capacity to display 16 simultaneously moving objects. The visual display must be free of apparent and distracting quantization and other distracting visual effects while the simulator is in motion. An SOC is required.			X	X		

Table A1A – Aeroplane - Minimum Simulator Requirements								
Entry No.	General Simulator Requirements	Simulator Level				Notes		
		A	B	C	D			
6.q.	The simulator must provide operational visual scenes that portray physical relationships known to cause landing illusions to pilots.			X	X	For example: short runways, landing approaches over water, uphill or downhill runways, rising terrain on the approach path, unique topographic features.		
6.r.	The simulator must provide special weather representations of light, medium, and heavy precipitation near a thunderstorm on takeoff and during approach and landing. Representations need only be presented at and below an altitude of 2,000 ft. (610 m) above the airport surface and within 10 miles (16 km) of the airport.			X	X			
6.s.	The simulator must present visual scenes of wet and snow-covered runways, including runway lighting reflections for wet conditions, partially obscured lights for snow conditions, or suitable alternative effects.			X	X			
6.t.	The simulator must present realistic color and directionality of all airport lighting.			X	X			
6.u.	The following weather effects as observed on the visual system must be simulated and respective instructor controls provided. (1) Multiple cloud layers with adjustable bases, tops, sky coverage and scud effect; (2) Storm cells activation and/or deactivation; (3) Visibility and runway visual range (RVR), including fog and patchy fog effect; (4) Effects on own-ship external lighting; (5) Effects on airport lighting (including variable intensity and fog effects); (6) Surface contaminants (including wind blowing effect); (7) Variable precipitation effects (rain, hail, snow); (8) In-cloud airspeed effect; and (9) Gradual visibility changes entering and breaking out of cloud.			X	X	Scud effects are low, detached, and irregular clouds below a defined cloud layer. Atmospheric model should support representative effects of wake turbulence and mountain waves as needed to enhance UPRT training. The mountain wave model should support the atmospheric climb, descent, and roll rates which can be encountered in mountain wave and rotor conditions.		
6.v.	The simulator must 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.			X	X	Visual effects for light poles and raised edge lights are for the purpose of providing additional depth perception during takeoff, landing, and taxi training tasks. Three dimensional modeling of the actual poles and stanchions is not required.		
7. SOUND SYSTEM								
7.a.	The simulator must provide flight deck sounds that result from pilot actions that correspond to those that occur in the aeroplane.	X	X	X	X			

Table A1A – Aeroplane - Minimum Simulator Requirements							
Entry No.	General Simulator Requirements	Simulator Level				Notes	
		A	B	C	D		
7.b.	The volume control must have an indication of sound level setting which meets all qualification requirements.					For Level D simulators, this indication should be readily available to the instructor on or about the IOS and is the sound level setting required to meet the objective testing requirements as described in Appendix 4A2 Table A2A. For all other simulator levels, this indication is the sound level setting as evaluated during the simulator's initial evaluation.	
7.c.	The simulator must accurately simulate the sound of precipitation, windshield wipers, and other significant aeroplane noises perceptible to the pilot during normal and abnormal operations, and include the sound of a crash (when the simulator is landed in an unusual attitude or in excess of the structural gear limitations); normal engine and thrust reversal sounds; and the sounds of flap, gear, and spoiler extension and retraction. Sounds must be directionally representative. A SOC is required.			X	X	For simulators qualified for full stall training tasks, sounds associated with stall buffet should be replicated if significant in the aeroplane.	
7.d.	The simulator must provide realistic amplitude and frequency of flight deck noises and sounds. Simulator performance must be recorded, compared to amplitude and frequency of the same sounds recorded in the aeroplane, and be made a part of the QTG.				X		

Table A1B - Tasks vs. Simulator Level – Subjective Requirements

Table A1B - Tasks vs. Simulator Level – Subjective Requirements							
Entry #	Subjective Requirements In order to be qualified at the FFS level indicated by the (X), the simulator must be able to perform at least the tasks indicated herein.	Simulator Levels				Notes	
		A	B	C	D		
1. PREFLIGHT PROCEDURES.							
1.a.	Preflight Inspection (flight deck only)	X	X	X	X		
1.b.	Engine Start	X	X	X	X		
1.c.	Taxiing		R	X	X		
1.d.	Pre-takeoff Checks	X	X	X	X		
2. TAKEOFF AND DEPARTURE PHASE.							
2.a.	Normal and Crosswind Takeoff		R	X	X		
2.b.	Instrument Takeoff	X	X	X	X		
2.c.	Engine Failure During Takeoff	X	X	X	X		
2.d.	Rejected Takeoff	X	X	X	X		
2.e.	Departure Procedure	X	X	X	X		
3. INFLIGHT MANEUVERS.							
3.a.	Steep Turns	X	X	X	X		
3.b.	High Angle of Attack Maneuvers :						
3.b.1	Approaches to Stall	X	X	X	X		
3.b.2	Full Stall			X	X	Stall maneuvers at angles of attack above the activation of the stall warning system. Required only for FSTDs qualified to conduct full stall training tasks as indicated on the Statement of Qualification.	
3.c.	Engine Failure—Multiengine Aeroplane	X	X	X	X		
3.d.	Engine Failure—Single-Engine Aeroplane	X	X	X	X		
3.e.	Specific Flight Characteristics incorporated into the user’s Transport Canada approved flight training program.	a	a	a	a		
3.f.	Recovery From Unusual Attitudes	X	X	X	X	Within the normal flight envelope supported by applicable simulation validation data.	

Table A1B - Tasks vs. Simulator Level – Subjective Requirements							
Entry #	Subjective Requirements In order to be qualified at the FFS level indicated by the (X), the simulator must be able to perform at least the tasks indicated herein.	Simulator Levels				Notes	
		A	B	C	D		
3.g.	Upset Prevention and Recovery Training (UPRT)			X	X	Upset recovery or unusual attitude training maneuvers within the FSTD's validation envelope that are intended to exceed pitch attitudes greater than 25 degrees nose up; pitch attitudes greater than 10 degrees nose down, and bank angles greater than 45 degrees.	
4. INSTRUMENT PROCEDURES							
4.a.	Standard Terminal Arrival / Flight Management System Arrivals Procedures	X	X	X	X		
4.b.	Holding	X	X	X	X		
4.c.	Precision Instrument	X	X	X	X		
4.c.1	All engines operating.	X	X	X	X	e.g., Autopilot, Manual (Flt. Dir. Assisted), Manual (Raw Data)	
4.c.2	One engine inoperative.	X	X	X	X	e.g., Manual (Flt. Dir. Assisted), Manual (Raw Data)	
4.d.	Non-precision Instrument Approach.	X	X	X	X	e.g., NDB, VOR, VOR/DME, VOR/TAC, RNAV, LOC, LOC/BC, ADF, and SDF.	
4.d.	Circling Approach	X	X	X	X	Specific authorization required.	
4.f.	Missed Approach :						
4.f.1	Normal.	X	X	X	X		
4.f.2	One engine Inoperative.	X	X	X	X		
5. LANDINGS AND APPROACHES TO LANDINGS.							
5.a.	Normal and Crosswind Approaches and Landings		R	X	X		
5.b.	Landing From a Precision / Non-Precision Approach		R	X	X		
5.c.	Approach and Landing with (Simulated) Engine Failure – Multiengine Aeroplane		R	X	X		
5.d.	Landing From Circling Approach		R	X	X		
5.e.	Rejected Landing	X	R	X	X		
5.f.	Landing From a No Flap or a Nonstandard Flap Configuration Approach		R	X	X		
6. NORMAL AND ABNORMAL PROCEDURES.							
6.a.	Engine (including shutdown and restart)	X	X	X	X		
6.a.	Fuel System	X	X	X	X		
6.c.	Electrical System	X	X	X	X		
6.d.	Hydraulic System	X	X	X	X		

Table A1B - Tasks vs. Simulator Level – Subjective Requirements							
Entry #	Subjective Requirements In order to be qualified at the FFS level indicated by the (X), the simulator must be able to perform at least the tasks indicated herein.	Simulator Levels				Notes	
		A	B	C	D		
6.e.	Environmental and Pressurization Systems	X	X	X	X		
6.f.	Fire Detection and Extinguisher Systems	X	X	X	X		
6.g.	Navigation and Avionics Systems	X	X	X	X		
6.h.	Automatic Flight Control System, Electronic Flight Instrument System, and Related Subsystems	X	X	X	X		
6.i.	Flight Control Systems	X	X	X	X		
6.j.	Anti-ice and Deice Systems	X	X	X	X		
6.k.	Aircraft and Personal Emergency Equipment	X	X	X	X		
7. EMERGENCY PROCEDURES.							
7.a.	Emergency Descent (Max. Rate)	X	X	X	X		
7.b.	Inflight Fire and Smoke Removal	X	X	X	X		
7.c.	Rapid Decompression	X	X	X	X		
7.d.	Emergency Evacuation	X	X	X	X		
8. POST-FLIGHT PROCEDURES.							
8.a.	After-Landing Procedures	X	X	X	X		
8.b.	Parking and Securing	X	X	X	X		

“(a)” — indicates that the system, task, or procedure may be examined if the appropriate aircraft system or control is simulated in the FSTD and is working properly.

“(R)” — indicates that the simulator may be qualified for this task for continuing qualification training only.

“A, B, C, D” — indicates that the simulator must be able to perform this task for this level of qualification.

Table A1C – Aeroplane - Table of Simulator System Tasks – Subjective Requirements

Table A1C – Aeroplane - Table of Simulator System Tasks – Subjective Requirements							
Entry #	Subjective Requirements In order to be qualified at the FFS level indicated by the (X), the simulator must be able to perform at least the tasks indicated herein.	Simulator Levels				Notes	
		A	B	C	D		
1. INSTRUCTOR OPERATING STATION (IOS), AS APPROPRIATE.							
1.a.	Power switch (es).	X	X	X	X		
1.b.	Aeroplane conditions	X	X	X	X	e.g., GW, CG, Fuel loading and Systems.	
1.c.	Airports / Runway.	X	X	X	X	e.g., Selection, Surface, Pre-sets, Lighting controls.	
1.d.	Environmental controls	X	X	X	X	e.g., Clouds, Visibility, RVR, Temp, Wind, Ice, Snow, Rain, and Windshear. Appropriate defaults for nominal flight conditions on system boot up.	
1.e.	Aeroplane system malfunctions (insertion / deletion)	X	X	X	X		
1.f.	Locks, Freezes, and Repositioning	X	X	X	X		
2. SOUND CONTROLS.							
2.a.	On / Off / adjustment	X	X	X	X		
3. MOTION / CONTROL LOADING SYSTEM.							
3.a.	On / Off / emergency stop	X	X	X	X		
4. OBSERVER SEATS / STATIONS							
4.a	Position / Adjustment / Position restraint system.	X	X	X	X		

4.19.8

Appendix A2 - Aeroplane FFS – Objective Tests

Introduction

1. For the purposes of this appendix, the flight conditions specified in the Flight Conditions Column of Table A2A are defined as follows:
 - a. Ground—on ground, independent of aeroplane configuration;
 - b. Take-off—gear down with flaps/slats in any certified takeoff position;
 - c. First segment climb—gear down with flaps/slats in any certified takeoff position (normally not above 50 ft. AGL);
 - d. Second segment climb—gear up with flaps/slats in any certified takeoff position (normally between 50 ft. and 400 ft. AGL);
 - e. Clean—flaps/slats retracted and gear up;
 - f. Cruise—clean configuration at cruise altitude and airspeed;
 - g. Approach—gear up or down with flaps/slats at any normal approach position as recommended by the aeroplane manufacturer; and
 - h. Landing—gear down with flaps/slats in any certified landing position.
2. The format for numbering the objective tests must match those in Table A2A. When a test number (or series of numbers) is not required, the term “Reserved” is used in the table at that location.
3. If relevant winds are present in the objective data, the wind vector should be clearly noted as part of the data presentation, expressed in conventional terminology, and related to the runway being used for the test.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests										
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes	
Entry #	Title				A	B	C	D		
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.		X	X	X		
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.		X	X	X		
1.b.	Takeoff Note. — All aeroplane manufacturer commonly-used certificated take-off flap settings must 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.	Takeoff	Acceleration time and distance must be recorded for a minimum of 80% of the total time from brake release to Vr. Preliminary aircraft certification data may be used.	X	X	X	X	May be combined with normal takeoff (1.b.4.) or rejected takeoff (1.b.7.). Plotted data should be shown using appropriate scales for each portion of the maneuver.	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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.	Takeoff	Engine failure speed must be within ±1 kt of aeroplane engine failure speed. Engine thrust decay must be that resulting from the mathematical model for the engine applicable to the FSTD under test. If the modeled 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.	X	X	X	X	If a V_{mcg} test is not available, an acceptable alternative is a flight test snap engine deceleration to idle at a speed between V₁ and V₁-10 kt, followed by control of heading using aerodynamic control only and recovery should be achieved with the main gear on the ground. To ensure only aerodynamic control, nosewheel steering should be disabled (i.e. castor) or the nosewheel held slightly off the ground.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
1.b.3	Minimum unstick speed (Vmu) or equivalent test to demonstrate early rotation take-off characteristics.	±3 kt. airspeed. ±1.5° pitch angle.	Takeoff	Record time history data from 10 knots before start of rotation until at least 5 seconds after the occurrence of main gear lift-off.	X	X	X	X	Vmu 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 Vmu test is not available, alternative acceptable flight tests are a constant high-attitude takeoff run through main gear lift-off or an early rotation takeoff. If either of these alternative solutions is selected, aft body contact/tail strike protection functionality, if present on the aeroplane, should be active.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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.	Takeoff	Data required for near maximum certificated takeoff weight at mid center of gravity location and light takeoff weight at an aft center of gravity location. If the aeroplane has more than one certificated takeoff configuration, a different configuration must be used for each weight. Record takeoff profile from brake release to at least 61 m (200 ft.) AGL.	X	X	X	X	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 maneuver.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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° side-slip 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; and ±2.2 daN (5 lbf) or ±10% of rudder pedal force.	Takeoff	Record takeoff profile to at least 61 m (200 ft) AGL. Engine failure speed must be within ±3 kt of aeroplane data. Test at near maximum takeoff weight.	X	X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
1.b.6	Crosswind takeoff.	± 3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±6 m (20 ft) height. ±2° roll angle. ±2° side-slip 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; and ±2.2 daN (5 lbf) or ±10% of rudder pedal force.	Takeoff	Record takeoff 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 must be provided as headwind and crosswind values with respect to the runway.	X	X	X	X	In those situations where a maximum crosswind or a maximum demonstrated crosswind is not known, contact the MSP.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
1.b.7	Rejected Takeoff.	±5% of time or ±1.5 s. ±7.5% of distance or ±76 m (250 ft).	Takeoff	Record at mass near maximum takeoff weight. Speed for reject must be at least 80% of V1. 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 must be recorded from brake release to a full stop.	X	X	X	X	Autobrakes will be used where applicable.
1.b.8	Dynamic Engine Failure After Takeoff.	±2°/s or ±20% of body angular rates.	Takeoff	Engine failure speed must 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. CCA: Test in Normal and Non-normal control state.			X	X	For safety considerations, aeroplane flight test may be performed out of ground effect at a safe altitude, but with correct aeroplane configuration and airspeed.
1.c.	Climb								

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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	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).	X	X	X	X	
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.	Flight test data is preferred; however, aeroplane performance manual data is 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.	X	X	X	X	
1.c.3	One Engine Inoperative Enroute Climb.	±10% time, ±10% distance, ±10% 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.			X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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.	Approach	Flight test data or aeroplane performance manual data may be used. FSTD performance to be recorded over an interval of at least 300 m (1,000 ft). Test near maximum certificated landing weight as may be applicable to an approach in icing conditions.	X	X	X	X	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								
1.d.1	Level flight acceleration	±5% 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.	X	X	X	X	
1.d.2	Level flight deceleration.	±5% 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.	X	X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
1.d.3	Cruise performance.	±0.05 EPR or ±3% N1 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.			X	X	
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).	X	X	X	X	
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.	FSTD performance to be recorded over an interval of at least 900 m (3,000 ft).	X	X	X	X	Stabilized descent to be conducted with speed brakes extended if applicable, at mid altitude and near Vmo or according to emergency descent procedure.
1.e.	Stopping								

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
1.e.1	Deceleration time and distance - manual wheel brakes, dry runway, no reverse thrust.	± 1.5 s or $\pm 5\%$ of time. For distances up to 1,220 m (4, 000 ft), the smaller of ± 61 m (200 ft) or $\pm 10\%$ of distance. For distances greater than 1,220 m (4, 000 ft), $\pm 5\%$ of distance.	Landing	Time and distance must be recorded for at least 80% of the total time from touchdown to a full stop. Position of ground spoilers and brake system pressure must be plotted (if applicable). Data required for medium and near maximum certificated landing mass. Engineering data may be used for the medium mass condition.	X	X	X	X	
1.e.2	Deceleration time and distance - reverse thrust, no wheel brakes, dry runway.	± 1.5 s or $\pm 5\%$ of time; and The smaller of ± 61 m (200 ft) or $\pm 10\%$ of distance.	Landing	Time and distance must 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 must be plotted (if applicable). Data required for medium and near maximum certificated landing mass. Engineering data may be used for the medium mass condition.	X	X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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 must 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.			X	X	
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 must 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.			X	X	
1.f.	Engines								
1.f.1	Acceleration	±10% Ti or ±0.25 s; and ±10% Tt or ±0.25 s.	Approach or landing	Total response is the incremental change in the critical engine parameter from idle power to go-around power.	X	X	X	X	See Chapter 1 of this manual for definitions of Ti, and Tt.
1.f.2	Deceleration	±10% Ti or ±0.25 s; and ±10% Tt or ±0.25 s.	Ground	Total response is the incremental change in the critical engine parameter from idle power to go-around power.	X	X	X	X	See Chapter 1 of this manual for definitions of Ti, and Tt.
2. HANDLING QUALITIES									

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests									
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.a.	Static Control Tests								
	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.a	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	Record results for an uninterrupted control sweep to the stops.	X	X	X	X	Test results should be validated with in-flight data from tests such as longitudinal static stability, stalls, etc.
2.a.1.b	(Reserved)								

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.a.2.a	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	Record results for an uninterrupted control sweep to the stops.	X	X	X	X	Test results should be validated with in-flight data from tests such as engine-out trims, steady state side-slips, etc.
2.a.2.b	(Reserved)								
2.a.3.a	Rudder pedal position versus force and surface position calibration.	±0.9 daN (2 lbf) breakout. ±1.3 daN (3 lbf) or ±10% of force. ±2° NWA.	Ground	Record results for an uninterrupted control sweep to the stops.	X	X	X	X	Test results should be validated with in-flight data from tests such as engine-out trims, steady state side-slips, etc.
2.a.3.b	(Reserved)								

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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	Record results for an uninterrupted control sweep to the stops.	X	X	X	X	
2.a.5	Rudder Pedal Steering Calibration.	±2° NWA.	Ground	Record results for an uninterrupted control sweep to the stops.	X	X	X	X	
2.a.6	Pitch Trim Indicator vs. Surface Position Calibration.	±0.5° trim angle.	Ground		X	X	X	X	The purpose of the test is to compare FSTD surface position and indicator against the flight control model computed value.
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 must be used.	X	X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.a.8	Alignment of cockpit throttle lever versus selected engine parameter.	When matching engine parameters: ±5° of TLA. When matching detents: ±3% N1 or ±0.3 EPR or ±3% torque, or equivalent. Where the levers do not have angular travel, a tolerance of ±2 cm (±0.8 in) applies.	Ground	Simultaneous recording for all engines. The tolerances apply against aeroplane data. 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.	X	X	X	X	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	Relate the hydraulic system pressure to pedal position in a ground static test. Both left and right pedals must be checked.	X	X	X	X	FFS computer output results may be used to show compliance.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.a.10	Stick Pusher System Force Calibration (if applicable)	$\pm 10\%$ or ± 5 lb (2.2 daN) Stick/Column force	Ground or Flight	Test is intended to validate the stick/column transient forces as a result of a stick pusher system activation. This test may be conducted in an on-ground condition through stimulation of the stall protection system in a manner that generates a stick pusher response that is representative of an in-flight condition.			X	X	Aircraft manufacturer design data may be utilized as validation data as determined acceptable by the MSP. Test requirement may be met through column force validation testing in conjunction with the Stall Characteristics test (2.c.8.a.). This test is required only for FSTDs qualified to conduct full stall training tasks.
2.b.	Dynamic Control Tests 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 Section 4.7 of this Chapter.								
2.b.1	Pitch Control.	For underdamped systems: T(P0) $\pm 10\%$ of P0 or ± 0.05 s. T(P1) $\pm 20\%$ of P1 or ± 0.05 s. T(P2) $\pm 30\%$ of P2 or ± 0.05 s.	Takeoff, Cruise, and Landing.	Data must 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 maneuvering load envelope). Tolerances apply against the absolute values of each period (considered independently).			X	X	n = the sequential period of a full oscillation. Refer to Section 4.7 of this Chapter. For over-damped and critically damped systems, see Figure 4-2 of in Section 4.7 of this Chapter for an

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
		$T(P_n) \pm 10 \cdot (n+1)\%$ of P_n or ± 0.05 s. $T(A_n) \pm 10\%$ of A_{max}, where A_{max} is the largest amplitude or $\pm 0.5\%$ of the total control travel (stop to stop). $T(A_d) \pm 5\%$ of A_d = residual band or $\pm 0.5\%$ of the maximum control travel = residual band. ± 1 significant overshoots (minimum of 1 significant overshoot). Steady state position within residual band. Note 1. — Tolerances should not be applied on period or amplitude							illustration of the reference measurement.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
		after the last significant overshoot. Note 2. — Oscillations within the residual band are not considered significant and are not subject to tolerances. For over damped and critically damped systems only , the following tolerance applies: $T(P0) \pm 10\% \text{ of } P0 \text{ or } \pm 0.05 \text{ s.}$							
2.b.2	Roll Control.	Same as 2.b.1.	Takeoff, Cruise, and Landing.	Data must 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 maneuvering load envelope).			X	X	Refer to Section 4.7 of this Chapter. For over-damped and critically damped systems, see Figure 4-2 of in Section 4.7 of this Chapter for an illustration of the reference measurement.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.b.3	Yaw Control.	Same as 2.b.1.	Takeoff, Cruise, and Landing.	Data must be for normal control displacement (approximately 25% to 50% of full throw).			X	X	Refer to Section 4.7 of this Chapter. For over-damped and critically damped systems, see Figure 4-2 of in Section 4.7 of this Chapter for an illustration of the reference measurement.
2.b.4	Small Control Inputs – Pitch.	$\pm 0.15^\circ/\text{s}$ body pitch rate or $\pm 20\%$ of peak body pitch rate applied throughout the time history.	Approach or Landing.	Control inputs must be typical of minor corrections made while established on an ILS approach (approximately 0.5 to $2^\circ/\text{s}$ 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 must be a minimum of 5 s before control reversal to the opposite direction. CCA: Test in normal and non-normal control state.			X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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 must 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 behavior, 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 must be a minimum of 5 s before control reversal to the opposite direction. CCA: Test in normal and non-normal control state.			X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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 must 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 must be a minimum of 5 s before control reversal to the opposite direction. CCA: Test in normal and non-normal control state.			X	X	
2.C.	Longitudinal Control Tests Note: Power setting is that required for level flight unless otherwise specified.								

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.C.1	Power Change Dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Approach	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	X	X	X	X	
2.C.2	Flap/Slat Change Dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Takeoff through initial flap retraction, and approach to landing.	Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the reconfiguration change to the completion of the reconfiguration change + 15 s. CCA: Test in normal and non-normal control mode	X	X	X	X	
2.C.3	Spoiler/Speedbrake Change Dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Cruise.	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	X	X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.C.4	Gear Change Dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Takeoff (retraction), and Approach (extension).	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	X	X	X	X	
2.C.5	Longitudinal Trim.	±1° elevator angle. ±0.5° stabilizer or trim surface 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.	X	X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.C.6	Longitudinal Maneuvering 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.	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. CCA: Test in normal or non-normal control mode	X	X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.C.7	Longitudinal Static Stability.	± 2.2 daN (5 lbf) or $\pm 10\%$ of pitch controller force. Alternative method: $\pm 1^\circ$ or $\pm 10\%$ of the change of elevator angle.		Data for at least two speeds above and two speeds below trim speed. The speed range must 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. CCA: Test in normal or non-normal control mode, as applicable.	X	X	X	X	

2.C.8.a	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 upon Nz component. Control inputs must be plotted and demonstrate correct trend and magnitude. Approach to stall: ±2.0° pitch angle; ±2.0° angle of attack; and ±2.0° bank angle Stall warning up to stall: ±2.0° pitch angle; ±2.0° angle of attack; And Correct trend and magnitude for roll rate and yaw rate. Stall Break and Recovery:	Second Segment Climb, High Altitude Cruise (Near Performance Limited Condition), And Approach or Landing	Each of the following stall entries must be demonstrated in at least one of the three flight conditions: - Stall entry at wings level (1g) - Stall entry in turning flight of at least 25° bank angle (accelerated stall) - Stall entry in a power-on condition (required only for propeller driven aircraft) The cruise flight condition must be conducted in a flaps-up (clean) configuration. The second segment climb flight condition must use a different flap setting than the approach or landing flight condition. Record the stall warning signal and initial buffet, if applicable. Time history data must be recorded for full stall through recovery to normal flight. The stall warning signal must occur in the proper relation to buffet/stall. FSTDs of aeroplanes exhibiting a sudden pitch attitude change or “g break” must demonstrate this characteristic. FSTDs of aeroplanes exhibiting a roll off or loss of roll control authority must demonstrate this characteristic. Numerical tolerances are not applicable past the stall angle of attack, but must demonstrate correct trend through recovery. See Attachment 7 for additional requirements and information concerning data sources and required angle of attack ranges. CCA: Test in normal and non-normal control states. For CCA aircraft with stall envelope protection systems, the normal mode testing is only required to an angle of attack range necessary to demonstrate the correct operation of the system. These tests may be used to				X	X	- Buffet threshold of perception should be based on 0.03 g peak to peak normal acceleration above the background noise at the pilot seat. Initial buffet to be based on normal acceleration at the pilot seat with a larger peak to peak value relative to buffet threshold of perception (some airframe manufacturers have used 0.1 g peak to peak). Demonstrate correct trend in growth of buffet amplitude from initial buffet to stall speed for normal and lateral acceleration. - The FSTD sponsor/FSTD manufacturer may limit maximum buffet based on motion platform capability/limitations or other simulator system limitations. Tests may be conducted at centers of gravity and weights typically required for aeroplane certification stall testing. - This test is required only for FSTDs qualified to conduct full stall training tasks. - In instances where flight test validation data is limited due to safety of flight considerations, engineering simulator validation data may be used in lieu of flight test validation data for angles of attack that exceed the

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
		SOC Required (see Attachment 7) Additionally, for those simulators with reversible flight control systems or equipped with stick pusher systems: ±10% or ±5 lb (2.2 daN)) Stick/Column force (prior to the stall angle of attack).		satisfy the required (angle of attack) flight maneuver and envelope protection tests (test 2.h.6.). Non-normal control states must be tested through stall identification and recovery.					activation of a stall protection system or stick pusher system. Where approved engineering simulation validation is used, the reduced engineering tolerances (as defined in Section 4.4 of this Chapter) do not apply.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.C.8.b	Approach to Stall Characteristics	±3 kt airspeed for stall warning speeds. ±2.0° angle of attack for initial buffet. Control displacements and flight control surfaces must be plotted and demonstrate correct trend and magnitude. ±2.0° pitch angle; ±2.0° angle of attack; and ±2.0° bank angle Additionally, for those simulators with reversible flight control systems: ±10% or ±5 lb (2.2 daN)) Stick/Column force	Second Segment Climb, High Altitude Cruise (Near Performance Limited Condition), And Approach or Landing	Each of the following stall entries must be demonstrated in at least one of the three flight conditions: - Stall entry at wings level (1g) - Stall entry in turning flight of at least 25° bank angle (accelerated stall) - Stall entry in a power-on condition (required only for propeller driven aircraft) The cruise flight condition must be conducted in a flaps-up (clean) configuration. The second segment climb flight condition must use a different flap setting than the approach or landing flight condition. CCA: Test in Normal and Non-normal control states. For CCA aircraft with stall envelope protection systems, the normal mode testing is only required to an angle of attack range necessary to demonstrate the correct operation of the system. These tests may be used to satisfy the required (angle of attack) flight maneuver and envelope protection tests (test 2.h.6.).	X	X			Tests may be conducted at centers of gravity and weights typically required for aeroplane certification stall testing. Tolerances on stall buffet are not applicable where the first indication of the stall is the activation of the stall warning system (i.e. stick shaker).

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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 must 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.	X	X	X	X	
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.	X	X	X	X	
2.C.11	(Reserved)								
2.d.	Lateral Directional Tests. Note: Power setting is that required for level flight unless Otherwise specified.								
2.d.1	Minimum control speed, air (Vmca) or landing (Vmcl), per applicable airworthiness requirement or low speed engine-inoperative handling characteristics in the air.	±3 kt airspeed.	Takeoff or Landing (whichever is most critical in the aeroplane).	Takeoff thrust must be set on the operating engine(s). Time history or snapshot data may be used. CCA: Test in normal or non-normal control state, as applicable.	X	X	X	X	Minimum speed may be defined by a performance or control limit which prevents demonstration of Vmca or Vmcl in the conventional manner.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.d.2	Roll Response (Rate).	$\pm 2^\circ/\text{s}$ or $\pm 10\%$ of roll rate. For aeroplanes with reversible flight control systems: $\pm 1.3 \text{ daN}$ (3 lbf) or $\pm 10\%$ of wheel force.	Cruise, and Approach or Landing.	Test with normal roll control displacement (approximately one-third of maximum roll controller travel). This test may be combined with step input of flight deck roll controller test 2.d.3.	X	X	X	X	
2.d.3	Step input of flight deck roll controller.	$\pm 2^\circ$ or $\pm 10\%$ of roll angle.	Approach or Landing.	This test may be combined with roll response (rate) test 2.d.2. CCA: Test in normal and non-normal control mode	X	X	X	X	With wings level, apply a step roll control input using approximately one-third of the roll controller travel. When reaching approximately 20° to 30° of bank, abruptly return the roll controller to neutral and allow approximately 10 seconds of aeroplane free response.
2.d.4	Spiral Stability.	Correct trend and $\pm 2^\circ$ or $\pm 10\%$ of roll angle in 20 s. If alternate test is used: correct trend and $\pm 2^\circ$ 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.	X	X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.d.5	Engine Inoperative Trim.	$\pm 1^\circ$ rudder angle or $\pm 1^\circ$ tab angle or equivalent rudder pedal. $\pm 2^\circ$ side-slip angle.	Second Segment Climb, and Approach or Landing.	This test may consist of snapshot tests.	X	X	X	X	Test should be performed in a manner similar to that for which a pilot is trained to trim an engine failure condition. 2nd segment climb test should be at takeoff thrust. Approach or landing test should be at thrust for level flight.
2.d.6	Rudder Response.	$\pm 2^\circ/\text{s}$ or $\pm 10\%$ 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	X	X	X	X	
2.d.7	Dutch Roll	$\pm 0.5 \text{ s}$ or $\pm 10\%$ of period. $\pm 10\%$ of time to one half or double amplitude or ± 0.02 of damping ratio. $\pm 1 \text{ s}$ or $\pm 20\%$ of time difference between peaks of roll angle and side-slip angle.	Cruise, and Approach or Landing.	Test for at least six cycles with stability augmentation off. CCA: Test in non-normal control mode.		X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.d.8	Steady State Sideslip.	For a given rudder position: ±2° roll angle; ±1° side-slip angle; ±2° or ±10% of aileron angle; and ±5° or ±10% of spoiler or equivalent roll controller position or force. 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.	Approach or Landing.	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 must be near maximum allowable rudder.	X	X	X	X	
2.e.	Landing								

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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. CCA: Test in normal and non-normal control mode, if applicable.		X	X	X	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.
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 Certified Landing Flap Configuration.	Test from a minimum of 61 m (200 ft) AGL to nosewheel touchdown. Test at near maximum certificated landing weight.			X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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° side-slip 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. Test data is required, 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 must be provided as headwind and crosswind values with respect to the runway.		X	X	X	In those situations where a maximum crosswind or a maximum demonstrated crosswind is not known, contact the MSP.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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° side-slip 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.		X	X	X	
2.e.5	Autopilot landing (if applicable).	±1.5 m (5 ft) flare height. ±0.5 s or ± 10% of T_{f_i} . ±0.7 m/s (140 ft/min) rate of descent at touchdown. ±3 m (10 ft) lateral deviation during roll-out.	Landing	If 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 engage and main gear touchdown must be noted.		X	X	X	See Chapter 1 of this manual for definition of T_{f_i} .
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 must be demonstrated (if applicable) at medium weight.		X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.e.7	One engine inoperative go around.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±2° roll angle. ±2° side-slip angle.	As per aeroplane performance data.	Engine inoperative go-around required near maximum certificated landing weight 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.		X	X	X	
2.e.8	Directional control (rudder effectiveness) with symmetric reverse thrust.	±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.		X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.e.9	Directional control (rudder effectiveness) with asymmetric reverse thrust.	±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.		X	X	X	
2.f.	Ground Effect								

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.f.	Test to demonstrate Ground Effect.	$\pm 1^\circ$ elevator angle. $\pm 0.5^\circ$ stabilizer angle. $\pm 5\%$ of net thrust or equivalent. $\pm 1^\circ$ AOA. ± 1.5 m (5 ft) or $\pm 10\%$ of height. ± 3 kt airspeed. $\pm 1^\circ$ pitch angle.	Landing	A rationale must be provided with justification of results. CCA: Test in normal or non-normal control mode, as applicable.		X	X	X	See Section 4.8 of this Chapter for additional information.
2.g.	Windshear								
2.g.	Four tests, two takeoff and two landing, with one of each conducted in still air and the other with windshear active to demonstrate windshear models.	See Section 4.8 of this Chapter.	Takeoff and Landing.	Requires windshear models that provide training in the specific skills needed to recognize windshear phenomena and to execute recovery procedures. See Section 4.8 of this Chapter for tests, tolerances, and procedures.			X	X	See Section 4.8 of this Chapter for information related to Level A and B simulators.
2.h.	Flight Maneuver And 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 their function is different) are required. Set thrust as required to reach the envelope protection function.								
2.h.1	Overspeed.	± 5 kt airspeed.	Cruise			X	X	X	
2.h.2	Minimum Speed.	± 3 kt airspeed.	Takeoff, Cruise, and Approach or Landing.			X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.h.3	Load Factor.	±0.1g normal load factor	Takeoff, Cruise			X	X	X	
2.h.4	Pitch Angle.	±1.5° pitch angle	Cruise, Approach			X	X	X	
2.h.5	Bank Angle.	±2° or ±10% bank angle	Approach			X	X	X	
2.h.6	Angle of Attack.	±1.5° angle of attack	Second Segment Climb, and Approach or Landing.			X	X	X	



Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes	
Entry #	Title				A	B	C	D		
2.i.	Engine And Airframe Icing Effects									
2.i.	Engine and Airframe Icing Effects Demonstration (High Angle of Attack)		Takeoff or Approach or Landing [One flight condition – two tests (ice on and off)]	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 is not required. Two tests are required to demonstrate engine and airframe icing effects. One test will demonstrate the FSTDs baseline performance without ice accretion, and the second test will demonstrate the aerodynamic effects of ice accretion relative to the baseline test. The test must utilize the icing model(s) as described in the required Statement of Compliance in Table A1A, Section 2.j. Test must include rationale that describes the icing effects being demonstrated. Icing effects may include, but are not limited to, the following effects as applicable to the particular aeroplane type: - 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 - Engine effects (power reduction/variation, vibration, etc. where expected to be present on the aircraft in the ice accretion scenario being tested)				X	X	Tests will be evaluated for representative effects on relevant aerodynamic and other parameters such as angle of attack, control inputs, and thrust/power settings. Plotted parameters must include: - Altitude - Airspeed - Normal acceleration - Engine power - Angle of attack - Pitch attitude - Bank angle - Flight control inputs - Stall warning and stall buffet onset
3. MOTION SYSTEM										

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
3.a	Frequency response.	As specified by the sponsor for FSTD qualification.	Not applicable.	Appropriate test to demonstrate required frequency response.	X	X	X	X	See Section 4.9 of this Chapter.
3.b	Turn-around check.	As specified by the sponsor for FSTD qualification.	Not applicable.	Appropriate test to demonstrate required frequency response.	X	X	X	X	See Section 4.9 of this Chapter.
3.c	Motion effects.				X	X	X	X	Refer to Table A3D of this Appendix on subjective testing.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
3.d	Motion system repeatability	±0.05 g actual platform linear accelerations.	None		X	X	X	X	Ensure 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 4.9.3 of this Chapter.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
3.e	Motion cueing fidelity – Frequency-domain criterion.	As specified by the sponsor for FSTD qualification.	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 simulated aircraft. This test is only required for initial FSTD qualification.			X	X	Testing may be accomplished by the FSTD manufacturer and results provided as a statement of compliance.
2.f.	Characteristic Motion Vibrations. Note: The following tests with recorded results and an SOC are required for characteristic motion vibrations, which can be sensed at the flight deck where applicable by aeroplane type. The recorded test results for characteristic buffets should allow the comparison of relative amplitude versus frequency. Also see paragraph 9.9.4 of this Chapter.								
2.f.1	Thrust effect with brakes set.	The FSTD test results must exhibit the overall appearance and trends of the aeroplane data, with at least three (3) of the predominant frequency “spikes” being present within ± 2 Hz of the aeroplane data.	Ground.	Test must be conducted at maximum possible thrust with brakes set.				X	
2.f.2	Buffet with landing gear extended.		Flight	Test must be conducted at maximum possible thrust with brakes set.				X	
2.f.3	Buffet with flaps extended.		Flight	Test must be conducted at maximum possible thrust with brakes set.				X	
2.f.4	Buffet with speedbrakes deployed.		Flight	Test must be conducted at maximum possible thrust with brakes set.				X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
2.f.5	Stall buffet	± 2 Hz of the aeroplane data.	Cruise (High Altitude), Second Segment Climb, and Approach or Landing.	Tests must be conducted for an angle of attack range between the buffet threshold of perception to the pilot and the stall angle of attack. Post stall characteristics are not required.			X	X	If stabilized flight data between buffet threshold of perception and the stall angle of attack are not available, PSD analysis should be conducted for a time span between initial buffet and the stall angle of attack. Test required only for FSTDs qualified for full stall training tasks or for those aircraft which exhibit stall buffet before the activation of the stall warning system.
2.f.6	Buffet at high airspeeds or high Mach.							X	Test condition should be for high-speed maneuver buffet/wind-up-turn or alternatively Mach buffet.
2.f.7	In-flight vibrations for propeller driven aeroplanes.							X	Test should be conducted to be representative of in-flight vibrations for propeller-driven aeroplanes.
4. VISUAL SYSTEM									
4.a.	Visual Scene Quality								

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
4.a.1	Continuous collimated cross-cockpit visual field of view.	Cross-cockpit, collimated visual display providing each pilot with a minimum of 176° horizontal and 36° vertical continuous field of view.	Not applicable.	Required as part of MQTG but not required as part of continuing evaluations.			X	X	Field of view should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares. Installed alignment should be confirmed in an SOC (this would generally consist of results from acceptance testing).
4.a.1	Continuous collimated cross-cockpit visual field of view.	Continuous collimated field-of-view providing at least 45° horizontal and 30° vertical field-of-view for each pilot seat. Both pilot seat visual systems must be operable.	Not applicable.	Required as part of MQTG but not required as part of continuing evaluations.	X	X			A vertical field-of-view of 30° may be insufficient to meet visual ground segment requirements.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
4.a.2	System geometry	5° even angular spacing within $\pm 1^\circ$ as measured from either pilot eye point and within 1.5° for adjacent squares.	Not applicable.	The angular spacing of any chosen 5° square and the relative spacing of adjacent squares must be within the stated tolerances.	X	X	X	X	The purpose of this test is to evaluate local linearity of the displayed image at either pilot eye point. System geometry should be measured using a visual test pattern filling the entire visual scene (all channels) with a matrix of black and white 5° squares with light points at the intersections. For continuing qualification 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.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
4.a.3	Surface resolution (Object detection).	Not greater than 2 arc minutes.	Not applicable.	An SOC is required and must include the relevant calculations and an explanation of those calculations. This requirement is applicable to any level of simulator equipped with a daylight visual system.			X	X	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 eye-point. The object will subtend 2 arc minutes to the eye. This may be demonstrated using threshold bars for a horizontal test. A vertical test should also be demonstrated. The subtended angles should be confirmed by calculations in an SOC.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
4.a.4	Light point size.	Not greater than 5 arc minutes.	Not applicable.	An SOC is required and must include the relevant calculations and an explanation of those calculations. This requirement is applicable to any level of simulator equipped with a daylight visual system.			X	X	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 eye-point 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.

4.a.5	Raster surface contrast ratio.	Not less than 5:1.	Not applicable.	This requirement is applicable to any level of simulator equipped with a daylight visual system.			X	X	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 center of each channel. Measurement should be made on the center bright square for each channel using a 1° spot photometer. This value should have a minimum brightness of 7 cd/m² (2 ft-lamberts). Measure any adjacent dark squares. The contrast ratio is the bright square value divided. 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 center of squares to avoid light spill into the measurement device.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
4.a.6	Light point contrast ratio.	Not less than 25:1.	Not applicable.	An SOC is required and must include the relevant calculations.			X	X	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 1. — Light point modulation should be just discernible on calligraphic systems but will not be discernable on raster systems. Measurements of the background should be taken such that the bright square is just out of the light meter FOV. Note 2. — During contrast ratio testing, FSTD aft-cab and flight deck ambient light levels should be as low as practical.
4.a.6	Light point contrast ratio.	Not less than 10:1.	Not applicable.		X	X			

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
4.a.7	Light point brightness.	Not less than 20 cd/m ² (5.8 ft-lamberts).	Not applicable.				X	X	Light points should be displayed as a matrix creating a square. On calligraphic systems the light points should just merge. 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.	This requirement is applicable to any level of simulator equipped with a daylight visual system.			X	X	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.
4.a.9	Black level and sequential contrast.	Black intensity: Background brightness – Black polygon brightness <	Not applicable.		X	X	X	X	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.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
		0.015 cd/m ² (0.004 ft-lamberts). Sequential contrast: Maximum brightness – (Background brightness – Black polygon brightness) > 2,000:1.							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.
4.a.10	Motion blur.	When a pattern is rotated about the eye-point at 10°/s, the smallest detectable gap must be 4 arc min or less.	Not applicable.		X	X	X	X	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 min. The pattern is rotated at the required rate.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
									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 MSP should be consulted on the limitations. This test is generally only required for light valve projectors.
4.a.11	Speckle test.	Speckle contrast must be < 10%.	Not applicable.		X	X	X	X	Alignment requirement applies to any HUD system in use or both simultaneously if they are used simultaneously for training.
4.b.	Head-Up Display (HUD)								

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
4.b.1	Static Alignment.	Static alignment with displayed image. HUD bore sight must align with the center of the displayed image spherical pattern. Tolerance +/- 6 arc min.	Not applicable.				X	X	Alignment requirement applies to any HUD system in use or both simultaneously if they are used simultaneously for training.
4.b.2	System display.	All functionality in all flight modes must be demonstrated.	Not applicable.				X	X	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				X	X	
4.c.	Enhanced Flight Vision System (EFVS)								
4.c.1	Registration test.	Alignment between EFVS display and out of the window image must represent the alignment typical of the aircraft and system type.	Takeoff point and on approach at 200 ft.				X	X	Note. — The effects of the alignment tolerance in 4.b.1 should be taken into account.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
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				X	X	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.				X	X	The scene will correctly represent the thermal characteristics of the scene during a day to night transition.
4.d.	Visual Ground Segment								
4.d.1	Visual ground segment (VGS).	Near end: the correct number of approach lights within the computed VGS must be visible. Far end: $\pm 20\%$ of the computed VGS. The threshold lights computed to be visible must 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: 1) RVR/Visibility; 2) glide slope (G/S) and localizer modeling accuracy (location and slope) for an ILS; 3) for a given weight, configuration and speed representative of a point within the aeroplane's operational envelope for a normal approach and landing; and 4) Radio altimeter. Note. — If non-homogeneous fog is used, the vertical variation in horizontal visibility should	X	X	X	X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
				be described and included in the slant range visibility calculation used in the VGS computation.					
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.				X	X	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

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
4.e.2	System capacity – Twilight/night mode.		Not applicable.				X	X	should be displayed simultaneously.
5. SOUND SYSTEM									
Note: The sponsor will not be required to repeat the aeroplane tests (i.e., tests 5.a.1. through 5.a.8. (or 5.b.1. through 5.b.9.) and 5.c., as appropriate) during continuing qualification evaluations if frequency response and background noise test results are within tolerance when compared to the initial qualification evaluation results, and the sponsor shows that no software changes have occurred that will affect the aeroplane test results. If the frequency response test method is chosen and fails, the sponsor may elect to fix the frequency response problem and repeat the test or the sponsor may elect to repeat the aeroplane tests. If the aeroplane tests are repeated during continuing qualification evaluations, the results may be compared against initial qualification evaluation results or aeroplane master data. All tests in this section must be presented using an un-weighted 1/3-octave band format from band 17 to 42 (50 Hz to 16 kHz). A minimum 20 second average must be taken at the location corresponding to the aeroplane data set. The aeroplane and flight simulator results must be produced using comparable data analysis techniques.									
5.a.	Turbo-Jet Aeroplanes.								

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests									
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
	All tests in this section should be presented using an un-weighted 1/3-octave band format from at least band 17 to 42 (50 Hz to 16 kHz). A measurement of minimum 20 s should be taken at the location corresponding to the approved data set. The approved data set and FSTD results should be produced using comparable data analysis techniques. Refer to paragraph 4.10 of this Chapter.								
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.				X	For initial evaluation, it is 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. Where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
5.a.2	All engines at idle.		Ground	Normal condition prior to takeoff.				X	
5.a.3	All engines at maximum allowable thrust with brakes set.		Ground	Normal condition prior to takeoff.				X	
5.a.4	Climb		Enroute climb.	Medium altitude.				X	
5.a.5	Cruise		Cruise.	Normal cruise configuration.				X	
5.a.6	Speed brake/spoilers extended (as appropriate).		Cruise	Normal and constant speed brake deflection for descent at a constant airspeed and power setting.				X	
5.a.7	Initial approach.		Approach.	Constant airspeed, gear up, flaps/slats as appropriate.				X	
5.a.8	Final approach.		Landing.	Constant airspeed,				X	

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests										
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes	
Entry #	Title				A	B	C	D		
5.b.	Propeller-Driven Aeroplanes									
	All tests in this section should be presented using an un-weighted 1/3-octave band format from at least band 17 to 42 (50 Hz to 16 kHz). A measurement of minimum 20 s should be taken at the location corresponding to the approved data set. The approved data set and FSTD results should be produced using comparable data analysis techniques. Refer to paragraph 4.10 of this Chapter.									
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.				X	For initial evaluation, it is 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. Where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.	
5.b.2	All propellers feathered, if applicable.		Ground	Normal condition prior to takeoff.				X		
5.b.3	Ground idle or equivalent.		Ground.	Normal condition prior to takeoff.				X		
5.b.4	Flight idle or equivalent.		Ground.	Normal condition prior to takeoff.				X		
5.b.5	All engines at maximum allowable power with brakes set.		Ground.	Normal condition prior to takeoff.				X		
5.b.6	Climb.		Enroute climb.	Medium altitude.				X		
5.b.7	Cruise		Cruise.	Normal cruise configuration.				X		
5.b.8	Initial approach.		Approach.	Constant airspeed, gear up, flaps extended as appropriate, RPM as per operating manual.				X		

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
5.b.9	Final approach.		Landing.	Constant airspeed, gear down, landing configuration flaps, RPM as per operating manual.				X	
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.						X	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 initial evaluation, it is 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. Where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
5.d.	FSTD background noise	Initial evaluation: background noise levels must fall below the sound levels described in Paragraph 4.10.3 e) of this Chapter. Recurrent evaluation: ± 3 dB per 1/3 octave band compared to initial evaluation.		Results of the background noise at initial qualification must be included in the QTG document and approved by the MSP. The measurements are to be made with the simulation running, the sound muted and a dead cockpit.					The simulated sound will be evaluated to ensure that the background noise does not interfere with training. Refer to Paragraph 4.10.3 e) of this Chapter. This test should be presented using an un-weighted 1/3 octave band format from band 17 to 42 (50 Hz to 16 kHz).

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 continuing qualification evaluations in lieu of aeroplane tests. The results must be approved by the MSP during the initial qualification. This test should be presented using an un-weighted 1/3 octave band format from band 17 to 42 (50 Hz to 16 kHz).

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
6. SYSTEMS INTEGRATION									
6.a.	System Response Time								

Table A2A – Aeroplane Full Flight Simulator (FFS) Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry #	Title				A	B	C	D	
6.a.1	Transport delay.	Motion system and instrument response: 100 ms (or less) after aeroplane response. Visual system response: 120 ms (or less) after aeroplane response.	Pitch, roll and yaw.						One separate test is required in each axis. Where EFVS systems are installed, the EFVS response should be within + or - 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.
6.a.1	Transport delay.	300 milliseconds or less after controller movement.	Pitch, roll and yaw.						

Table A2B – Aeroplane Alternative Data Sources, Procedures, and Instrumentation (Level A and B FSTDs)

Table A2B – Aeroplane Alternative Data Sources, Procedures, and Instrumentation (Level A and B FSTDs)				
Test No.	Objective Tests Title	Sim Level	Alternative Data Sources, Procedures, and Instrumentation	Notes/Information
Note: The standards in this table are required if the data gathering methods described in Section 4.2 are not used.				
PERFORMANCE - TAXI				
1.a.1	Minimum Radius turn	A, B	TIR, AFM, or Design data may be used.	
1.a.2	Rate of Turn vs. Nosewheel Steering Angle	B	Data may be acquired by using a constant tiller position, measured with protractor or full rudder pedal application for steady state turn, and synchronized video of heading indicator. If less than full rudder pedal is used, pedal position must be recorded.	A single procedure may not be adequate for all airplane steering systems, therefore appropriate measurement procedures must be devised and proposed for MSP concurrence.
PERFORMANCE - TAKEOFF				
1. b.1	Ground Acceleration Time and Distance	A, B	Preliminary certification data may be used. Data may be acquired by using a stop watch, calibrated airspeed, and runway markers during a takeoff with power set before brake release. Power settings may be hand recorded. If an inertial measurement system is installed, speed and distance may be derived from acceleration measurements.	
1.b.2	Minimum Control Speed - ground (V _{mcg}) using aerodynamic controls only (per applicable airworthiness standard) or low speed, engine inoperative ground control characteristics	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls.	Rapid throttle reductions at speeds near V _{mcg} may be used while recording appropriate parameters. The nosewheel must be free to caster, or equivalently freed of side force generation.

Table A2B – Aeroplane Alternative Data Sources, Procedures, and Instrumentation (Level A and B FSTDs)

Test No.	Objective Tests Title	Sim Level	Alternative Data Sources, Procedures, and Instrumentation	Notes/Information
1.b.3	Minimum Unstick Speed (Vmu) or equivalent test to demonstrate early rotation takeoff characteristics.	A, B		
1.b.4	Normal Takeoff	A,B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls. AOA can be calculated from pitch attitude and flight path.	
1.B.5	Critical Engine Failure during Takeoff	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls.	Record airplane dynamic response to engine failure and control inputs required to correct flight path.
1.b.6	Crosswind Takeoff	A, B		The “1:7 law” to 100 feet (30 meters) is an acceptable wind profile.
1.b.7	Rejected Takeoff	A, B	Data may be acquired with a synchronized video of calibrated airplane instruments, thrust lever position, engine parameters, and distance (e.g., runway markers). A stop watch is required.	
PERFORMANCE - CLIMB				
1.c.1	Normal Climb all engines operating.	A, B	Data may be acquired with a synchronized video of calibrated airplane instruments and engine power throughout the climb range.	
1.c.2	One engine Inoperative Climb	A, B		
1.c.4	One Engine Inoperative Approach Climb (if operations in icing conditions are authorized)	A, B		
CRUISE / DESCENT				
1.d.1	Level flight acceleration.	A, B		

Table A2B – Aeroplane Alternative Data Sources, Procedures, and Instrumentation (Level A and B FSTDs)

Test No.	Objective Tests Title	Sim Level	Alternative Data Sources, Procedures, and Instrumentation	Notes/Information
1.d.2	Level flight deceleration.	A, B	Data may be acquired with a synchronized video of calibrated airplane instruments, thrust lever position, engine parameters, and elapsed time.	
1.d.4	Idle descent.	A, B		
1.d.5	Emergency Descent.	A, B		
PERFORMANCE – GROUND - STOPPING				
1.e.1	Deceleration time and distance, - wheel brakes and no reverse thrust on a dry runway.	A, B	Data may be acquired during landing tests using a stop watch, runway markers, and a synchronized video of calibrated airplane instruments, thrust lever position and the pertinent parameters of engine power.	
1.e.2	Deceleration Time and Distance, using reverse thrust and no wheel brakes.	A, B		
PERFORMANCE - ENGINES				
1.f.1	Acceleration	A, B	Data may be acquired with a synchronized video recording of engine instruments and throttle position.	
1.f.2	Deceleration	A, B		
HANDLING QUALITIES - STATIC CONTROL CHECKS				
2.a.1.a	Pitch Controller Position vs. Force and Surface Position Calibration	A, B	Surface position data may be acquired from flight data recorder (FDR) sensor or, if no FDR sensor, at selected, significant column positions (encompassing significant column position data points), acceptable to the MSP, using a control surface protractor on the ground. Force data may be acquired by using a hand held force gauge at the same column position data points.	For airplanes with reversible control systems, surface position data acquisition should be accomplished with winds less than 5 kts.
2.a.2.a	Roll Controller Position vs. Force and Surface Position Calibration	A, B		
2.a.3.a	Rudder Pedal Position vs. Force and Surface Position Calibration	A, B		

Table A2B – Aeroplane Alternative Data Sources, Procedures, and Instrumentation (Level A and B FSTDs)

Test No.	Objective Tests Title	Sim Level	Alternative Data Sources, Procedures, and Instrumentation	Notes/Information
2.a.4	Nosewheel Steering Controller Force and Position	A, B	Breakout data may be acquired with a hand held force gauge. The remainder of the force to the stops may be calculated if the force gauge and a protractor are used to measure force after breakout for at least 25% of the total displacement capability.	
2.a.5	Rudder Pedal Steering Calibration	A, B	Data may be acquired through the use of force pads on the rudder pedals and a pedal position measurement device, together with design data for nosewheel position.	
2.a.6	Pitch Trim Indicator vs. Surface Position Calibration.	A, B	Data may be acquired through calculations.	
2.a.7	Pitch trim rate.	A, B	Data may be acquired by using a synchronized video of pitch trim indication and elapsed time through range of trim indication.	
2.a.8	Alignment of Flight deck Throttle Lever Angle vs. Selected engine parameter.	A, B	Data may be acquired through the use of a temporary throttle quadrant scale to document throttle position. Use a synchronized video to record steady state instrument readings or hand-record steady state engine performance readings.	
2.a.9	Brake pedal position vs. force and brake system pressure calibration.	A, B	Use of design or predicted data is acceptable. Data may be acquired by measuring deflection at “zero” and “maximum” and calculating deflections between the extremes using the airplane design data curve.	
HANDLING QUALITIES - LONGITUDINAL CONTROL TESTS				
2.c.1	Power change dynamics	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and throttle position.	
2.c.2	Flap/slat change dynamics	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and flap/slat position.	
2.c.3	Spoiler/speedbrake change dynamics	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and spoiler/speedbrake position.	

Table A2B – Aeroplane Alternative Data Sources, Procedures, and Instrumentation (Level A and B FSTDs)

Test No.	Objective Tests Title	Sim Level	Alternative Data Sources, Procedures, and Instrumentation	Notes/Information
2.c.4	Gear change dynamics	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and gear position.	
2.c.5	Longitudinal trim	A, B	Data may be acquired through use of an inertial measurement system and a synchronized video of flight deck controls position (previously calibrated to show related surface position) and the engine instrument readings.	
2.c.6	Longitudinal maneuvering stability (stick force/g)	A, B	Data may be acquired through the use of an inertial measurement system and a synchronized video of calibrated airplane instruments; a temporary, high resolution bank angle scale affixed to the attitude indicator; and a wheel and column force measurement indication.	
2.c.7	Longitudinal static stability	A, B	Data may be acquired through the use of a synchronized video of airplane flight instruments and a hand held force gauge.	
2.c.8	Stall characteristics	A, B	Data may be acquired through a synchronized video recording of a stop watch and calibrated airplane airspeed indicator. Hand-record the flight conditions and airplane configuration.	Airspeeds may be cross checked with those in the TIR and AFM.
2.c.9	Phugoid dynamics	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls.	
2.c.10	Short period dynamics	B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls.	

Table A2B – Aeroplane Alternative Data Sources, Procedures, and Instrumentation (Level A and B FSTDs)

Test No.	Objective Tests Title	Sim Level	Alternative Data Sources, Procedures, and Instrumentation	Notes/Information
2.d.1	Handling qualities. Lateral directional tests. Minimum control speed, air (Vmca or Vmcl), per applicable airworthiness standard or Low speed engine inoperative handling characteristics in the air	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls.	
HANDLING QUALITIES - LATERAL DIRECTIONAL TESTS				
2.d.2	Roll response (rate).	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck lateral controls.	May be combined with step input of flight deck roll controller test, 2.d.3.
2.d.3	Roll response to flight deck roll controller step input	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck lateral controls.	
2.d.4	Spiral stability	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments; force/position measurements of flight deck controls; and a stop watch.	
2.d.5	Engine inoperative trim	A, B	Data may be hand recorded in-flight using high resolution scales affixed to trim controls that have been calibrated on the ground using protractors on the control / trim surfaces with winds less than 5 kts. OR Data may be acquired during second segment climb (with proper pilot control input for an engine-out condition) by using a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls.	Trimming during second segment climb is not a certification task and should not be conducted until a safe altitude is reached.

Table A2B – Aeroplane Alternative Data Sources, Procedures, and Instrumentation (Level A and B FSTDs)

Test No.	Objective Tests Title	Sim Level	Alternative Data Sources, Procedures, and Instrumentation	Notes/Information
2.d.6	Rudder response.	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of rudder pedals.	
2.d.7	Dutch roll, (yaw damper OFF)	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls.	
2.d.8	Steady state sideslip	A, B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls. Ground track and wind corrected heading may be used for sideslip	
HANDLING QUALITIES - LANDINGS				
2.e.1	Normal landing.	B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls.	
2.e.3	Crosswind landing.	B		
2.e.4	One engine inoperative landing.	B	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls.	
2.e.5	Autopilot landing (if applicable)	B		

Table A2B – Aeroplane Alternative Data Sources, Procedures, and Instrumentation (Level A and B FSTDs)

Test No.	Objective Tests Title	Sim Level	Alternative Data Sources, Procedures, and Instrumentation	Notes/Information
2.e.6	All engines operating, autopilot, go around.	B	Normal and lateral accelerations may be recorded in lieu of AOA and sideslip.	
2.e.7	One engine inoperative go around.	B		
2.e.8	Directional control (rudder effectiveness with symmetric thrust).	B		
2.e.9	Directional control (rudder effectiveness with asymmetric reverse thrust).	B		
2.f	Test to demonstrate ground effect	B	Data may be acquired by using calibrated airplane instruments, an inertial measurement system, and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls.	

4. Acceptance Guidelines for Alternative Engines Data.

1. Background

- a. For a new aeroplane type, the majority of flight validation data are collected on the first aeroplane configuration with a “baseline” engine type. These data are then used to validate all flight simulators representing that aeroplane type.
- b. Implementing an engine-type from a different manufacturer or a design change that differs from the baseline engine into an FSTD may significantly affect some QTG test results. Additional flight test validation data may be needed for flight simulators representing an aeroplane with engines of a different type than the baseline, or for engines with thrust rating that is different from previously validated configurations.
- c. To qualify a flight simulator with alternate engines, the QTG should contain tests validated against flight test data for selected cases where engine differences are expected to be significant.

2. Approval Guidelines for Validating Alternate Engine Applications. The following guidelines apply to flight simulators representing aeroplanes with alternate engine applications or with more than one engine type or thrust rating:

- a. Validation tests can be segmented into two groups, those that are dependent on engine type or thrust rating and those that are not.
 - 1) **Tests that are independent of engine type or thrust rating** can be based on validation data from any engine application. Tests in this category should be designated as independent of engine type or thrust rating.
 - 2) **Tests that are affected by engine type.** Test affected by engine type or thrust rating should be validated against engine-specific flight test data for each particular aeroplane-engine configuration. See Table A2C, Alternate Engine Validation Flight Tests in this section for a list of acceptable tests.
- b. Alternate engine validation data should be based on flight test data, except if conditions at paragraphs 3a and 3b are not exceeded, or where other data are specifically allowed (e.g., engineering simulator/simulation data).
 - 1) If certification of the flight characteristics of the aeroplane with a new thrust rating (regardless of percentage change) requires certification flight testing with a comprehensive stability and control flight instrumentation package, then the conditions described in Table A2C in this section should be obtained from flight testing and presented in the QTG.
 - 2) If the new thrust rating is certified on the aeroplane without need for a comprehensive stability and control flight instrumentation package, then flight test data, other than throttle calibration data, are not required
- c. As a supplement to the engine-specific flight tests listed in Table A2C and baseline engine-independent tests, additional engine-specific engineering validation data should be provided in the QTG, as appropriate, to facilitate running the entire QTG with the alternate engine configuration. The sponsor and the MSP should agree in advance on the specific validation tests to be supported by engineering simulation data.
- d. The QTG should include a supplementary Validation Road Map or matrix indicating the validation data source for each test using the alternate engine or thrust rating...
- e. The flight test conditions in Table A2C are appropriate and should be sufficient to validate implementation of alternate engines in a flight simulator.

3. Test Requirements. The QTG must contain selected engine-specific flight test data sufficient to validate the alternative thrust level when:

- a. The engine type is the same, but the thrust rating exceeds that of a previously flight-test validated configuration by five percent (5%) or more; or
- b. The engine type is the same, but the thrust rating is less than the lowest previously flight-test validated rating by fifteen percent (15%) or more. See Table A2C for a list of acceptable tests.
- c. Flight test data is not required if the thrust increase is greater than 5%, but flight tests have confirmed that the thrust increase does not change the aeroplane's flight characteristics.
- d. Throttle calibration data (i.e., commanded power setting parameter versus throttle position) must be provided to validate all alternate engine types and engine thrust ratings that are higher or lower than a previously validated engine. Data from a test aeroplane or engineering test bench with the correct engine controller (both hardware and software) are required.

Table A2C - Aeroplane Alternative Engine Validation Flight Tests

Table A2C - Aeroplane Alternative Engine Validation Flight Tests			
Entry No.	Test Description	Alternative	
		Engine Type	Thrust Rating ²
1.b.1 1.b.4	Normal take-off/ground acceleration time and distance	X	X
1.b.2	Vmcg, if performed for airplane certification	X	X
1.b.5	Engine-out take-off (may perform 1.b.8)	X	
1.b.8	Dynamic engine failure after take-off (may perform test 1.b.5)	X	
1.b.7	Rejected take-off if performed for airplane certification	X	
1.d.1	Cruise performance	X	
1.f.1 1.f.2	Engine acceleration and deceleration	X	X
2.a.7	Throttle calibration ¹	X	X
2.c.1	Power change dynamics (acceleration)	X	X
2.d.1	Vmca if performed for airplane certification	X	X
2.d.5	Engine inoperative trim	X	X
2.e.1	Normal landing	X	X

¹Must be provided for all changes in engine type or thrust rating; see paragraph 4.c.4).

²See paragraphs 4.c.1) through 4.c.3), for a definition of applicable thrust ratings.

Appendix A3 – Aeroplane FFS – Simulator Subjective Evaluation

Table A3A – Aeroplanes - Functions and Subjective Tests – Operations Tasks

Table A3A – Aeroplanes - Functions and Subjective Tests – Operations Tasks						
Entry #	Operations Tasks	Simulator Level				
		A	B	C	D	
Tasks in this table are subject to evaluation if appropriate for the airplane simulated as indicated in the SOQ Configuration List or the level of simulator qualification involved. Items not installed or not functional on the simulator and, therefore, not appearing on the SOQ Configuration List, are not required to be listed as exceptions on the SOQ.						
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 airplane being simulated.	X	X	X	X	
1.a.2	Reserved					
1.a.3	Reserved					
2. SURFACE OPERATIONS (PRE-FLIGHT).						
2.a.	Engine Start					
2.a.1	Normal start	X	X	X	X	
2.a.2	Alternate start procedures	X	X	X	X	
2.a.3	Abnormal starts and shutdowns (e.g., hot/hung start, tail pipe fire)	X	X	X	X	
2.b.	Taxi					
2.b.1	Pushback/powerback		X	X	X	
2.b.2	Thrust response	X	X	X	X	
2.b.3	Power lever friction	X	X	X	X	
2.b.4	Ground handling	X	X	X	X	
2.b.5	Nosewheel scuffing			X	X	
2.b.6	Taxi aids (e.g. taxi camera, moving map)			X	X	
2.b.7	Low visibility (taxi route, signage, lighting, markings, etc.)			X	X	
2.c.	Brake Operation					
2.c.1	Brake operation (normal and alternate/emergency)	X	X	X	X	
2.c.2	Brake fade (if applicable)	X	X	X	X	
3. TAKE-OFF.						
3.a.	Normal					
3.a.1	Airplane/engine parameter relationships, including run-up	X	X	X	X	
3.a.2	Nosewheel and rudder steering	X	X	X	X	
3.a.3.a	Crosswind (maximum demonstrated)	X	X	X	X	
3.a.3.b	Gusting crosswind			X	X	
3.a.4	Special performance					
3.a.4.a	Reduced V1	X	X	X	X	
3.a.4.b	Maximum engine de-rate	X	X	X	X	
3.a.4.c	Soft surface			X	X	
3.a.4.d	Short field/short take-off and landing (STOL) operations	X	X	X	X	
3.a.4.e	Obstacle (performance over visual obstacle)			X	X	
3.a.5	Low visibility take-off	X	X	X	X	
3.a.6	Landing gear, wing flap leading edge device operation	X	X	X	X	
3.a.7	Contaminated runway operation			X	X	
3.b.	Abnormal/emergency					
3.b.1	Rejected Take-off	X	X	X	X	
3.b.2	Rejected special performance (e.g., reduced V1, max de-rate, short field operations)	X	X	X	X	
3.b.3	Rejected take-off with contaminated runway			X	X	
3.b.4	Takeoff with a propulsion system malfunction (allowing an analysis of causes, symptoms, recognition, and the effects on aircraft performance and handling) at the following points: (i) Prior to V1 decision speed; (ii) Between V1 and Vr (rotation speed); and (iii)Between Vr and 500 feet above ground level.	X	X	X	X	
3.b.5	Flight control system failures, reconfiguration modes, manual reversion and associated handling.	X	X	X	X	

Table A3A – Aeroplanes - Functions and Subjective Tests – Operations Tasks					
Entry #	Operations Tasks	Simulator Level			
		A	B	C	D
4. CLIMB.					
4.a.	Normal.	X	X	X	X
4.b.	One or more engines inoperative.	X	X	X	X
4.c.	Approach climb in icing (for airplanes with icing accountability).	X	X	X	X
5. CRUISE.					
5.a.	Performance characteristics (speed vs. power, configuration, and attitude)				
5.a.1	Straight and level flight.	X	X	X	X
5.a.2	Change of airspeed.	X	X	X	X
5.a.3	High altitude handling.	X	X	X	X
5.a.4	High Mach number handling (Mach tuck, Mach buffet) and recovery (trim change).	X	X	X	X
5.a.5	Overspeed warning (in excess of Vmo or Mmo).	X	X	X	X
5.a.6	High IAS handling.	X	X	X	X
5.b.	Maneuvers				
5.b.1	High Angle of Attack				
5.b.1.a	High angle of attack, approach to stalls, stall warning, and stall buffet (take-off, cruise, approach, and landing configuration) including reaction of the autoflight system and stall protection system.	X	X		
5.b.1.b	High angle of attack, approach to stalls, stall warning, stall buffet, and stall (take-off, cruise, approach, and landing configuration) including reaction of the autoflight system and stall protection system.			X	X
5.b.2	Slow flight			X	X
5.b.3	Upset prevention and recovery maneuvers within the FSTD’s validation envelope.			X	X
5.b.4	Flight envelope protection (high angle of attack, bank limit, overspeed, etc.)	X	X	X	X
5.b.5	Turns with/without speedbrake/spoilers deployed	X	X	X	X
5.b.6	Normal and standard rate turns	X	X	X	X
5.b.7	Steep turns	X	X	X	X
5.b.8	Performance turn			X	X
5.b.9	In flight engine shutdown and restart (assisted and windmill)	X	X	X	X
5.b.10	Maneuvering with one or more engines inoperative, as appropriate	X	X	X	X
5.b.11	Specific flight characteristics (e.g. direct lift control)	X	X	X	X
5.b.12	Flight control system failures, reconfiguration modes, manual reversion and associated handling	X	X	X	X
5.b.13	Gliding to a forced landing			X	X
5.b.14	Visual resolution and FSTD handling and performance for the following (where applicable by aircraft type and training program):				
5.b.14.a	• Terrain accuracy for forced landing area selection;			X	X
5.b.14.b	• Terrain accuracy for VFR Navigation;			X	X
5.b.14.c	• Eights on pylons (visual resolution);			X	X
5.b.14.d	• Turns about a point; and			X	X
5.b.14.e	• S-turns about a road or section line.			X	X
6. DESCENT.					
6.a.	Normal	X	X	X	X
6.b.	Maximum rate/emergency (clean and with speedbrake, etc.).	X	X	X	X
6.c.	With autopilot.	X	X	X	X
6.d.	Flight control system failures, reconfiguration modes, manual reversion and associated handling.	X	X	X	X
7. INSTRUMENT APPROACHES AND LANDING.					
Note: Those instrument approach and landing tests relevant to the simulated airplane type are selected from the following list. Some tests are made with limiting wind velocities, under windshear conditions, and with relevant system failures, including the failure of the Flight Director. If Standard Operating Procedures allow use autopilot for non-precision approaches, evaluation of the autopilot will be included. Level A simulators are not authorized to credit the landing maneuver.					
7.a.	Precision approach				
7.a.1	CAT I published approaches.				
7.a.1.a	• Manual approach with/without flight director including landing.	X	X	X	X

Table A3A – Aeroplanes - Functions and Subjective Tests – Operations Tasks					
Entry #	Operations Tasks	Simulator Level			
		A	B	C	D
7.a.1.b	• Autopilot/autothrottle coupled approach and manual landing.	X	X	X	X
7.a.1.c	• Autopilot/autothrottle coupled approach, engine(s) inoperative.	X	X	X	X
7.a.1.d	• Manual approach, engine(s) inoperative.	X	X	X	X
7.a.1.e	• HUD/EFVS			X	X
7.a.2	CAT II published approaches.				
7.a.2.a	• Autopilot/autothrottle coupled approach to DH and landing (manual and autoland).	X	X	X	X
7.a.2.b	• Autopilot/autothrottle coupled approach with one-engine- inoperative approach to DH and go-around (manual and autopilot).	X	X	X	X
7.a.2.c	• HUD/EFVS			X	X
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).	X	X	X	X
7.a.3.b	• Autopilot/autothrottle coupled approach to DH and go-around (manual and autopilot).	X	X	X	X
7.a.3.c	• Autopilot/autothrottle coupled approach to land and roll-out (if applicable) guidance with one engine inoperative (manual and autoland).	X	X	X	X
7.a.3.d	• Autopilot/autothrottle coupled approach to DH and go-around with one engine inoperative (manual and autopilot).	X	X	X	X
7.a.3.e	• HUD/EFVS			X	X
7.a.4	Autopilot/autothrottle coupled approach (to a landing or to a go-around):				
7.a.4.a	• With generator failure;	X	X	X	X
7.a.4.b.1	• With maximum tail wind component certified or authorized;			X	X
7.a.4.b.2	• With 10 knot tail wind;	X	X		
7.a.4.c.1	• With maximum crosswind component demonstrated or authorized; and			X	X
7.a.4.c.2	• With 10 knot crosswind.	X	X		
7.a.5	PAR approach, all engine(s) operating and with one or more engine(s) inoperative	X	X	X	X
7.a.6	MLS, GBAS, all engine(s) operating and with one or more engine(s) inoperative	X	X	X	X
7.b.	Non-precision approach.				
7.b.1	Surveillance radar approach, all engine(s) operating and with one or more engine(s) inoperative	X	X	X	X
7.b.2	NDB approach, all engine(s) operating and with one or more engine(s) inoperative	X	X	X	X
7.b.3	VOR, VOR/DME, TACAN approach, all engines(s) operating and with one or more engine(s) inoperative	X	X	X	X
7.b.4	RNAV / RNP / GNSS (RNP at nominal and minimum authorized temperatures) approach, all engine(s) operating and with one or more engine(s) inoperative	X	X	X	X
7.b.5	ILS LLZ (LOC), LLZ back course (or LOC-BC) approach, all engine(s) operating and with one or more engine(s) inoperative	X	X	X	X
7.b.6	ILS offset localizer approach, all engine(s) operating and with one or more engine(s) inoperative	X	X	X	X
7.c	Approach procedures with vertical guidance (APV), e.g. SBAS, flight path vector				
7.c.1	APV/baro-VNAV approach, all engine(s) operating and with one or more engine(s) inoperative			X	X
7.c.2	Area navigation (RNAV) approach procedures based on SBAS, all engine(s) operating and with one or more engine(s) inoperative			X	X
8. VISUAL APPROACHES (VISUAL SEGMENT) AND LANDINGS.					
Note: Flight simulators with visual systems, which permit completing a special approach procedure in accordance with applicable regulations, may be approved for that particular approach procedure.					
8.a.	Maneuvering, normal approach and landing, all engines operating with and without visual approach aid guidance	X	X	X	X
8.b.	Approach and landing with one or more engines inoperative	X	X	X	X
8.c.	Operation of landing gear, flap/slats and speedbrakes (normal and abnormal)	X	X	X	X
8.d.1	Approach and landing with crosswind (max. demonstrated)	X	X	X	X
8.d.2	Approach and landing with gusting crosswind			X	X

Table A3A – Aeroplanes - Functions and Subjective Tests – Operations Tasks

Entry #	Operations Tasks	Simulator Level			
		A	B	C	D
8.e.	Approach and landing with flight control system failures, reconfiguration modes, manual reversion and associated handling (most significant degradation which is probable)	X	X	X	X
8.e.1	Approach and landing with trim malfunctions	X	X	X	X
8.e.1.a	• Longitudinal trim malfunction	X	X	X	X
8.e.1.b	• Lateral-directional trim malfunction	X	X	X	X
8.f.	Approach and landing with standby (minimum) electrical/hydraulic power	X	X	X	X
8.g.	Approach and landing from circling conditions (circling approach)	X	X	X	X
8.h.	Approach and landing from visual traffic pattern	X	X	X	X
8.i.	Approach and landing from non-precision approach	X	X	X	X
8.j.	Approach and landing from precision approach	X	X	X	X
9. MISSED APPROACH.					
9.a.	All engines, manual and autopilot.	X	X	X	X
9.b.	Engine(s) inoperative, manual and autopilot.	X	X	X	X
9.c.	Rejected landing			X	X
9.d.	With flight control system failures, reconfiguration modes, manual reversion and associated handling	X	X	X	X
9.e.	Bounced landing recovery			X	X
10. SURFACE OPERATIONS (landing, after-landing and post-flight).					
10.a	Landing roll and taxi				
10.a.1	HUD/EFVS			X	X
10.a.2	Spoiler operation	X	X	X	X
10.a.3	Reverse thrust operation	X	X	X	X
10.a.4	Directional control and ground handling, both with and without reverse thrust		X	X	X
10.a.5	Reduction of rudder effectiveness with increased reverse thrust (rear pod-mounted engines)		X	X	X
10.a.6	Brake and anti-skid operation				
10.a.6.a	Brake and anti-skid operation with dry, patchy wet, wet on rubber residue, and patchy icy conditions			X	X
10.a.6.b	Reserved				
10.a.6.c	Brake operation	X	X		
10.a.6.d	Auto-braking system operation	X	X	X	X
10.b	Engine shutdown and parking				
10.b.1	Engine and systems operation	X	X	X	X
10.b.2	Parking brake operation	X	X	X	X
11. ANY FLIGHT PHASE.					
11.a.	Airplane and engine systems operation (where fitted)				
11.a.1	Air conditioning and pressurization (ECS)	X	X	X	X
11.a.2	De-icing/anti-icing	X	X	X	X
11.a.3	Auxiliary power unit (APU).	X	X	X	X
11.a.4	Communications	X	X	X	X
11.a.5	Electrical	X	X	X	X
11.a.6	Fire and smoke detection and suppression	X	X	X	X
11.a.7	Flight controls (primary and secondary)	X	X	X	X
11.a.8	Fuel and oil	X	X	X	X
11.a.9	Hydraulic	X	X	X	X
11.a.10	Pneumatic	X	X	X	X
11.a.11	Landing gear	X	X	X	X
11.a.12	Oxygen	X	X	X	X
11.a.13	Engine	X	X	X	X
11.a.14	Airborne radar	X	X	X	X
11.a.15	Autopilot and Flight Director	X	X	X	X
11.a.16	Terrain awareness warning systems and collision avoidance systems (e.g. EGPWS, GPWS, TCAS)	X	X	X	X
11.a.17	Flight control computers including stability and control augmentation	X	X	X	X
11.a.18	Flight display systems	X	X	X	X

Table A3A – Aeroplanes - Functions and Subjective Tests – Operations Tasks					
Entry #	Operations Tasks	Simulator Level			
		A	B	C	D
11.a.19	Flight management computers	X	X	X	X
11.a.20	Head-up displays (including EFVS, if appropriate)	X	X	X	X
11.a.21	Navigation systems	X	X	X	X
11.a.22	Stall warning/avoidance	X	X	X	X
11.a.23	Wind shear avoidance/recovery guidance equipment	X	X	X	X
11.a.24	Flight envelope protections	X	X	X	X
11.a.25	Electronic flight bag			X	X
11.a.26	Automatic checklists (normal, abnormal and emergency procedures)			X	X
11.a.27	Runway alerting and advisory system			X	X
11.b.	Airborne procedures				
11.b.1	Holding	X	X	X	X
11.b.2	Air hazard avoidance (traffic, weather, including visual correlation)			X	X
11.b.3	Windshear				
11.b.3.a	• Prior to take-off rotation			X	X
11.b.3.b	• At lift-off			X	X
11.b.3.c	• During initial climb			X	X
11.b.3.d	• On final approach, below 150 m (500 ft) AGL			X	X
11.b.4	Effects of airframe ice			X	X

Table A3B – Aeroplane Class I Airport Models - Functions and Subjective Tests

Table A3B – Aeroplane Class I Airport Models - Functions and Subjective Tests					
Entry No.	Aeroplane Class I Visual Scene Models	Simulator Level			
		A	B	C	D
This table specifies the minimum airport model content and functionality to qualify a simulator at the indicated level. This table applies only to the airport models required for simulator qualification; i.e., one airport model for Level A and Level B simulators; three airport models for Level C and Level D simulators.					
1. FUNCTIONAL TEST CONTENT REQUIREMENTS FOR LEVEL A AND LEVEL B SIMULATORS. The following is the minimum airport model content requirement to satisfy visual capability tests, and provides suitable visual cues to allow completion of all functions and subjective tests described in this Appendix for simulators at Levels A and B.					
1.a.	A minimum of one (1) representative airport model. This model identification must be acceptable to the sponsor's TPAA, selectable from the IOS, and listed on the SOQ.	X	X		
1.b.	The fidelity of the airport model must be sufficient for the aircrew to visually identify the airport; determine the position of the simulated airplane within a night visual scene; successfully accomplish take-offs, approaches, and landings; and maneuver around the airport on the ground as necessary.	X	X		
1.c.	Runways				
1.c.1	Visible runway number.	X	X		
1.c.2	Runway threshold elevations and locations must be modeled to provide sufficient correlation with airplane systems (e.g., altimeter).	X	X		
1.c.3	Runway surface and markings.	X	X		
1.c.4	Lighting for the runway in use including runway edge and centerline.	X	X		
1.c.5	Lighting, visual approach aid and approach lighting of appropriate colors.	X	X		
1.c.6	Representative taxiway lights.	X	X		
2. ADDITIONAL FUNCTIONAL TEST CONTENT REQUIREMENTS					
2.a.	AIRPORT SCENES				
2.a.1.a	A minimum of three (3) real-world airport models to be consistent with published data used for airplane 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. The model identifications must be acceptable to the sponsor's TPAA, selectable from the IOS, and listed on the SOQ.			X	X
2.a.1.b	Reserved				
2.a.1.c	Reserved				
2.a.1.d	Airport model content. For circling approaches, all tests apply to the runway used for the initial approach and to the runway of intended landing. If all runways in an airport model used to meet the requirements of this Appendix are not designated as "in use," then the "in use" runways must be listed on the SOQ (e.g., KORD, Rwys 9R, 14L, 22R). Models of airports with more than one runway must have all significant runways not "in-use" visually depicted for airport and runway recognition purposes. The use of white or off white light strings that identify the runway threshold, edges, and ends for twilight and night scenes are acceptable for this requirement. Rectangular surface depictions are acceptable for daylight scenes. A visual system's capabilities must be balanced between providing airport models with an accurate representation of the airport and a realistic representation of the surrounding environment. Airport model detail must be developed using airport pictures, construction drawings and maps, or other similar data, or developed in accordance with published regulatory material; however, this does not require that such models contain details that are beyond the design capability of the currently qualified visual system. Only one "primary" taxi route from parking to the runway end will be required for each "in-use" runway.	X	X	X	X
2.a.2	Visual scene fidelity.				
2.a.2.a	The visual scene must correctly represent the parts of the airport and its surroundings used in the training program.	X	X	X	X
2.a.2.b	Reserved				
2.a.2.c	Reserved				

Table A3B – Aeroplane Class I Airport Models - Functions and Subjective Tests

Entry No.	Aeroplane Class I Visual Scene Models	Simulator Level			
		A	B	C	D
2.a.3	Runways and taxiways.				
2.a.3.a	Airport specific runways and taxiways.	X	X	X	X
2.a.3.b	Reserved				
2.a.3.c	Reserved				
2.a.4	If appropriate to the airport, two parallel runways and one crossing runway displayed simultaneously; at least two runways must be capable of being lit simultaneously.			X	X
2.a.5	Runway threshold elevations and locations must be modeled to provide correlation with airplane systems (e.g. HUD, GPS, compass, altimeter).			X	X
2.a.6	Slopes in runways, taxiways, and ramp areas must not cause distracting or unrealistic effects, including pilot eye-point height variation.			X	X
2.a.7	Runway surface and markings for each “in-use” runway must include the following, if appropriate:				
2.a.7.a	Threshold markings.	X	X	X	X
2.a.7.b	Runway numbers.	X	X	X	X
2.a.7.c	Touchdown zone markings.	X	X	X	X
2.a.7.d	Fixed distance markings.	X	X	X	X
2.a.7.e	Edge markings.	X	X	X	X
2.a.7.f	Center line markings.	X	X	X	X
2.a.7.g	Distance remaining signs.	X	X	X	X
2.a.7.h	Signs at intersecting runways and taxiways.	X	X	X	X
2.a.7.i	Windsock that gives appropriate wind cues.			X	X
2.a.8	Runway lighting of appropriate colors, directionality, behavior and spacing for the “in-use” runway including the following:				
2.a.8.a	Threshold lights.	X	X	X	X
2.a.8.b	Edge lights.	X	X	X	X
2.a.8.c	End lights.	X	X	X	X
2.a.8.d	Center line lights.	X	X	X	X
2.a.8.e	Touchdown zone lights.	X	X	X	X
2.a.8.f	Lead-off lights.	X	X	X	X
2.a.8.g	Appropriate visual landing aid(s) for that runway.	X	X	X	X
2.a.8.h	Appropriate approach lighting system for that runway.	X	X	X	X
2.a.9	Taxiway surface and markings (associated with each “in-use” runway):				
2.a.9.a	Edge markings	X	X	X	X
2.a.9.b	Center line markings.	X	X	X	X
2.a.9.c	Runway holding position markings.	X	X	X	X
2.a.9.d	ILS critical area markings.	X	X	X	X
2.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) must also be demonstrated at one airport model for those operations authorized in low visibilities. The designated runway and taxi routing must be consistent with that airport for operations in low visibilities. The qualification of surface movement guidance control systems (SMGCS) is optional at the request of the FSTD sponsor. For the qualification of SMGCS, a demonstration model must be provided for evaluation.				X
2.a.10	Taxiway lighting of appropriate colors, directionality, behavior and spacing (associated with each “in-use” runway):				
2.a.10.a	Edge lights.	X	X	X	X
2.a.10.b	Center line lights.	X	X	X	X
2.a.10.c	Runway holding position and ILS critical area lights.	X	X	X	X
2.a.11	Required visual model correlation with other aspects of the airport environment simulation.				
2.a.11.a	The airport model must be properly aligned with the navigational aids that are associated with operations at the runway “in-use”.	X	X	X	X
2.a.11.b	The simulation of runway contaminants must be correlated with the displayed runway surface and lighting.				X

Table A3B – Aeroplane Class I Airport Models - Functions and Subjective Tests

Entry No.	Aeroplane Class I Visual Scene Models	Simulator Level			
		A	B	C	D
2.a.12	Airport buildings, structures and lighting.				
2.a.12.a	Buildings, structures and lighting:				
2.a.12.a.1	Airport specific buildings, structures and lighting.			X	X
2.a.12.a.2	Reserved				
2.a.12.a.3	Reserved				
2.a.12.b	At least one useable gate, set at the appropriate height (required only for those airplanes that typically operate from terminal gates).			X	X
2.a.12.c	Representative moving and static airport clutter (e.g. other airplanes, power carts, tugs, fuel trucks, additional gates).			X	X
2.a.12.d	Gate/apron markings (e.g. hazard markings, lead-in lines, gate numbering), lighting and gate docking aids or a marshaller.			X	X
2.a.13	Terrain and obstacles.				
2.a.13.a	Terrain and obstacles within 46 km (25 NM) of the reference airport.			X	X
2.a.13.b	Reserved				
2.a.14	Significant, identifiable natural and cultural features and moving airborne traffic.				
2.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.			X	X
2.a.14.b	Reserved				
2.a.14.c	Representative moving airborne traffic (including the capability to present air hazards – e.g. airborne traffic on a possible collision course).			X	X
2. B VISUAL SCENE MANAGEMENT.					
2.b.1	All airport runway, approach and taxiway lighting and cultural lighting intensity for any approach must be capable of being set to six (6) different intensities (0 to 5); all visual scene light points should fade into view appropriately.			X	X
2.b.2	Airport runway, approach and taxiway lighting and cultural lighting intensity for any approach must 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.	X	X		
2.b.3	The directionality of strobe lights, approach lights, runway edge lights, visual landing aids, runway center line lights, threshold lights, and touchdown zone lights on the runway of intended landing must be realistically replicated.	X	X	X	X
2 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 airplane aligned with the runway on an extended 3-degree glide slope in suitable simulated meteorological conditions. For circling approaches, all tests below apply both to the runway used for the initial approach and to the runway of intended landing.					
2.c.1	Runway definition, strobe lights, approach lights, and runway edge white lights from 8 km (5 sm) of the runway threshold.	X	X	X	X
2.c.2.a	Visual approach aids lights from 8 km (5 sm) of the runway threshold.			X	X
2.c.2.b	Visual approach aids lights from 4.8 km (3 sm) of the runway threshold.	X	X		
2.c.3	Runway center line lights and taxiway definition from 4.8 km (3 sm).	X	X	X	X
2.c.4	Threshold lights and touchdown zone lights from 3.2 km (2 sm).	X	X	X	X
2.c.5	Runway markings within range of landing lights for night scenes; as required by the surface resolution test on day scenes.	X	X	X	X
2.c.6	For circling approaches, the runway of intended landing and associated lighting must fade into view in a non-distracting manner.	X	X	X	X
2.d SELECTABLE AIRPORT VISUAL SCENE CAPABILITY FOR:					
2.d.1	Night.	X	X	X	X
2.d.2	Twilight.			X	X

Table A3B – Aeroplane Class I Airport Models - Functions and Subjective Tests

Entry No.	Aeroplane Class I Visual Scene Models	Simulator Level			
		A	B	C	D
2.d.3	Day.			X	X
2.d.4	Dynamic effects —the capability to present multiple ground and air hazards such as another airplane crossing the active runway or converging airborne traffic; hazards should be selectable via controls at the instructor station.			X	X
2.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.				X
2. e CORRELATION WITH AIRPLANE AND ASSOCIATED EQUIPMENT.					
2.e.1	Visual cues to relate to actual airplane responses.	X	X	X	X
2.e.2	Visual cues during take-off, approach and landing.				
2.e.2.a	Visual cues to assess sink rate and depth perception during landings.		X	X	X
2.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.	X	X	X	X
2.e.3	Accurate portrayal of environment relating to airplane attitudes.	X	X	X	X
2.e.4	The visual scene must correlate with integrated airplane systems, where fitted (e.g. terrain, traffic and weather avoidance systems and HUD/EFVS).			X	X
2.e.5	The effect of rain removal devices must be provided.			X	X
2.f SCENE QUALITY.					
2.f.1	Quantization.				
2.f.1.a	Surfaces and textural cues must be free from apparent quantization (aliasing).			X	X
2.f.1.b	Surfaces and textural cues must not create distracting quantization (aliasing).	X	X		
2.f.2	System capable of portraying full color realistic textural cues.			X	X
2.f.3	The system light points must be free from distracting jitter, smearing or streaking.	X	X	X	X
2.f.4	System capable of providing representative focus effects that simulate rain (e.g. reduced visibility and object resolution in the out the window view as a result of rain).			X	X
2.f.5	System capable of providing light point perspective growth (e.g. relative size of runway and taxiway edge lights increase as the lights are approached).			X	X
2.g ENVIRONMENTAL EFFECTS.					
2.g.1	The displayed scene must correspond to the appropriate surface contaminants and include runway lighting reflections for wet, partially obscured lights for snow, or suitable alternative effects.			X	X
2.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.			X	X
2.g.3	One airport with a snow scene to include terrain snow and snow-covered taxiways and runways.			X	X
2.g.4	In-cloud effects such as variable cloud density, speed cues and ambient changes should be provided.			X	X
2.g.5	The effect of multiple cloud layers representing few, scattered, broken and overcast conditions giving partial or complete obstruction of the ground scene.			X	X
2.g.6	Gradual break-out to ambient visibility/RVR, defined as up to 10% of the respective cloud base or top, 20 ft ≤ transition layer ≤ 200 ft; cloud effects should be checked at and below a height of 600m (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.			X	X
2.g.7	Visibility and RVR measured in terms of distance. Visibility/RVR must 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.	X	X	X	X
2.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 greater than the IOS RVR.			X	X

Table A3B – Aeroplane Class I Airport Models - Functions and Subjective Tests

Entry No.	Aeroplane Class I Visual Scene Models	Simulator Level			
		A	B	C	D
2.g.9	Effects of fog on airport lighting such as halos and defocus.			X	X
2.g.10	Effect of own-ship lighting in reduced visibility, such as reflected glare, to include landing lights, strobes, and beacons.			X	X
2.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.			X	X

Table A3C – Aeroplane Class II Airport Models - Functions and Subjective Tests**Table A3C – Aeroplane Class II Airport Models - Functions and Subjective Tests**

Entry No.	Aeroplane Class II Visual Scene Models	Simulator Level			
		A	B	C	D

This table specifies the minimum airport model content and functionality necessary to add airport models to a simulator's model library, beyond those necessary for qualification at the stated level, without the necessity of further involvement of the MSP or TPAA.

1. AIRPORT MODEL MANAGEMENT. The following is the minimum airport model management requirements for simulators at Levels A, B, C, and D.

1.a.	The direction of strobe lights, approach lights, runway edge lights, visual landing aids, runway centerline lights, threshold lights, and touchdown zone lights on the "in-use" runway must be replicated.	X	X	X	X

2. VISUAL FEATURE RECOGNITION. The following are the minimum distances at which runway features must be visible for simulators at Levels A, B, C, and D. Distances are measured from runway threshold to an airplane aligned with the runway on an extended 3° glide-slope in simulated meteorological conditions that recreate the minimum distances for visibility. For circling approaches, all requirements of this section apply to the runway used for the initial approach and to the runway of intended landing.

2.a.	Runway definition, strobe lights, approach lights, and runway edge white lights from 5 sm (8 km) from the runway threshold.	X	X	X	X
2.b.	Visual Approach Aid lights (VASI or PAPI) from 5 sm (8 km) from the runway threshold.			X	X
2.c.	Visual Approach Aid lights (VASI or PAPI) from 3 sm (5 km) from the runway threshold.	X	X		
2.d.	Runway centerline lights and taxiway definition from 3 sm (5 km) from the runway threshold.	X	X	X	X
2.e.	Threshold lights and touchdown zone lights from 2 sm (3 km) from the runway threshold.	X	X	X	X
2.f.	Runway markings within range of landing lights for night scenes and as required by the surface resolution requirements on day scenes.	X	X	X	X
2.g.	For circling approaches, the runway of intended landing and associated lighting must fade into view in a non-distracting manner.	X	X	X	X

3. AIRPORT MODEL CONTENT. The following prescribes the minimum requirements for what must be provided in an airport model and identifies other aspects of the airport environment that must correspond with that model for simulators at Levels A, B, C, and D. The detail must be developed using airport pictures, construction drawings and maps, or other similar data, or developed in accordance with published regulatory material; however, this does not require that airport models contain details that are beyond the designed capability of the currently qualified visual system. For circling approaches, all requirements of this section apply to the runway used for the initial approach and to the runway of intended landing. Only one "primary" taxi route from parking to the runway end will be required for each "in-use" runway.

3.a.	The surface and markings for each "in-use" runway:				
3.a.1	Threshold markings.	X	X	X	X
3.a.2	Runway numbers.	X	X	X	X
3.a.3	Touchdown zone markings.	X	X	X	X
3.a.4	Fixed distance markings.	X	X	X	X
3.a.5	Edge markings.	X	X	X	X
3.a.6	Centerline stripes.	X	X	X	X
3.b.	The lighting for each "in-use" runway.				
3.b.1	Threshold lights.	X	X	X	X
3.b.2	Edge lights.	X	X	X	X
3.b.3	End lights.	X	X	X	X

Table A3C – Aeroplane Class II Airport Models - Functions and Subjective Tests

Entry No.	Aeroplane Class II Visual Scene Models	Simulator Level			
		A	B	C	D
3.b.4	Centerline lights.	X	X	X	X
3.b.5	Touchdown zone lights, if appropriate.	X	X	X	X
3.b.6	Leadoff lights, if appropriate.	X	X	X	X
3.b.7	Appropriate visual landing aid(s) for that runway.	X	X	X	X
3.b.8	Appropriate approach lighting system for that runway.	X	X	X	X
3.c.	The taxiway surface and markings associated with each “in-use” runway:				
3.c.1	Edge.	X	X	X	X
3.c.2	Centerline.	X	X	X	X
3.c.3	Runway hold lines.	X	X	X	X
3.c.4	ILS critical area markings.	X	X	X	X
3.d.	The taxiway lighting associated with each “in-use” runway:				
3.d.1	Edge.			X	X
3.d.2	Centerline.	X	X	X	X
3.d.3	Runway hold and ILS critical area lights.	X	X	X	X
4. REQUIRED MODEL CORRELATION WITH OTHER ASPECTS OF THE AIRPORT ENVIRONMENT SIMULATION.					
The following are the minimum model correlation tests that must be conducted for simulators at Levels A, B, C, and D.					
4.a.	The airport model must be properly aligned with the navigational aids that are associated with operations at the “in-use” runway.	X	X	X	X
4.b.	Slopes in runways, taxiways, and ramp areas, if depicted in the visual scene, must not cause distracting or unrealistic effects.	X	X	X	X
5. CORRELATION WITH AIRPLANE AND ASSOCIATED EQUIPMENT. The following are the minimum correlation comparisons that must be made for simulators at Levels A, B, C, and D.					
5.a.	Visual system compatibility with aerodynamic programming.	X	X	X	X
5.b.	Accurate portrayal of environment relating to flight simulator attitudes.	X	X	X	X
5.c.	Visual cues to assess sink rate and depth perception during landings.		X	X	X
5.d.	Visual effects for each visible, own-ship, airplane external light(s).		X	X	X
6.	SCENE QUALITY. The following are the minimum scene quality tests that must be conducted for simulators at Levels A, B, C, and D.				
6.a.	Surfaces and textural cues must be free of apparent and distracting quantization (aliasing).			X	X
6.b.	Correct color and realistic textural cues.			X	X
6.c.	Light points free from distracting jitter, smearing or streaking.	X	X	X	X
7. INSTRUCTOR CONTROLS OF THE FOLLOWING: The following are the minimum instructor controls that must be available in simulators at Levels A, B, C, and D.					
7.a.	Environmental effects, e.g., cloud base (if used), cloud effects, cloud density, visibility in statute miles/kilometers and RVR in feet/meters.	X	X	X	X
7.b.	Airport selection.	X	X	X	X
7.c.	Airport lighting including variable intensity.	X	X	X	X
7.d.	Dynamic effects including ground and flight traffic.			X	X
8.	Sponsors are not required to provide every detail of a runway, but the detail that is provided must be correct within the capabilities of the system.	X	X	X	X

Table A3D – Aeroplane - Functions and Subjective Tests – Motion System

Table A3D – Aeroplane - Functions and Subjective Tests – Motion System						
Entry No.	Motion System Effects	Simulator Level				Notes/Information
		A	B	C	D	
This table specifies motion effects that are required to indicate when a flight crewmember must be able to recognize an event or situation. Where applicable, flight simulator pitch, side loading and directional control characteristics must be representative of the airplane.						
1.	Taxiing effects such as lateral, longitudinal, and directional cues resulting from steering and braking inputs. Runway contamination with associated anti-skid and taxiway characteristics.			X	X	
2.	Runway rumble, oleo deflection, ground speed, uneven runway, runway/taxiway centerline light characteristics: Procedure: After the airplane has been pre-set to the takeoff position and then released, taxi at various speeds with a smooth runway and note the general characteristics of the simulated runway rumble effects of oleo deflections. Repeat the maneuver with a runway roughness of 50%, then with maximum roughness. Note the associated motion vibrations affected by ground speed and runway roughness.		X	X	X	Different gross weights can also be selected, which may also affect the associated vibrations depending on airplane type. The associated motion effects for the above tests should also include an assessment of the effects of rolling over centerline lights, surface discontinuities of uneven runways, and various taxiway characteristics.
3.	Buffets on the ground due to spoiler/speedbrake extension and reverse thrust: Procedure: Perform a normal landing and use ground spoilers and reverse thrust – either individually or in combination – to decelerate the simulated airplane. Do not use wheel braking so that only the buffet due to the ground spoilers and thrust reversers is felt.	X	X	X	X	
4.	Bumps associated with the landing gear: Procedure: Perform a normal take-off paying special attention to the bumps that could be perceptible due to maximum oleo extension after lift-off. When the landing gear is extended or retracted, motion bumps can be felt when the gear locks into position.	X	X	X	X	
5.	Buffet during extension and retraction of landing gear: Procedure: Operate the landing gear. Check that the motion cues of the buffet experienced represent the actual airplane.	X	X	X	X	
6.	Buffet in the air due to flap and spoiler/speedbrake extension: Procedure: Perform an approach and extend the flaps and slats with airspeeds deliberately in excess of the normal approach speeds. In cruise configuration, verify the buffets associated with the spoiler/speedbrake extension. The above effects can also be verified with different combinations of spoiler/speedbrake, flap, and landing gear settings to assess the interaction effects.	X	X	X	X	
7.	Buffet due to atmospheric disturbances (e.g. buffet due to turbulence, windshear, proximity to thunderstorms, gusting winds, etc.).			X	X	

Table A3D – Aeroplane - Functions and Subjective Tests – Motion System

Entry No.	Motion System Effects	Simulator Level				Notes/Information
		A	B	C	D	
8.	Approach to stall buffet and stall buffet (where applicable): Procedure: Conduct an approach-to-stall with engines at idle and a deceleration of 1 knot/second. Check that the motion cues of the	X	X	X	X	For FSTDs qualified for full stall training tasks, modeling that accounts for any 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 modeling should include effects of Nz, as well as Nx and Ny if relevant.
9.	Touchdown cues for main and nose gear: Procedure: Conduct several normal approaches with various rates of descent. Check that the motion cues for the touchdown bumps for each descent rate are representative of the actual airplane.	X	X	X	X	
10.	Nosewheel scuffing: Procedure: Taxi at various ground speeds and manipulate the nosewheel steering to cause yaw rates to develop that cause the nosewheel to vibrate against the ground (“scuffing”). Evaluate the speed/nosewheel combination needed to produce scuffing and check that the resultant vibrations are representative of the actual airplane.		X	X	X	
11.	Thrust effect with brakes set: Procedure: Set the brakes on at the take-off point and increase the engine power until buffet is experienced. Evaluate its characteristics. Confirm that the buffet increases appropriately with increasing engine thrust.	X	X	X	X	This effect is most discernible with wing-mounted engines
12.	Mach and maneuver buffet: Procedure: With the simulated airplane trimmed in 1 g flight while at high altitude, increase the engine power so that the Mach number exceeds the documented value at which Mach buffet is experienced. Check that the buffet begins at the same Mach number as it does in the airplane (for the same configuration) and that buffet levels are representative of the actual airplane. For certain airplanes, maneuver buffet can also be verified for the same effects. Maneuver buffet can occur during turning flight at conditions greater than 1 g, particularly at higher altitudes.		X	X	X	
13.	Tire failure dynamics: Procedure: Simulate a single tire failure and a multiple tire failure.			X	X	The pilot may notice some yawing with a multiple tire failure selected on the same side. This should require the use of the rudder to maintain control of the airplane. Dependent on airplane type, a single tire failure may not be noticed by the pilot and should not have any special motion effect. Sound or vibration may be associated with the actual tire losing pressure.

Table A3D – Aeroplane - Functions and Subjective Tests – Motion System

Entry No.	Motion System Effects	Simulator Level				Notes/Information
		A	B	C	D	
14.	Engine failures, malfunction, engine, and airframe structural damage: Procedure: The characteristics of an engine malfunction as stipulated in the malfunction definition document for the particular flight simulator must describe the special motion effects felt by the pilot. Note the associated engine instruments varying according to the nature of the malfunction and note the replication of the effects of the airframe vibration.		X	X	X	
15.	Tail strikes, engine pod/propeller, wing strikes: Procedure: Tail-strikes can be checked by over-rotation of the airplane at a speed below Vr while performing a takeoff. The effects can also be verified during a landing. Excessive banking of the airplane during its take-off/landing roll can cause a pod strike.		X	X	X	The motion effect should be felt as a noticeable bump. If the tail strike affects the airplane angular rates, the cueing provided by the motion system should have an associated effect

Appendix B1 – Rotorcraft FFS – General Simulator Requirements.

1. This Appendix describes the general simulator requirements for qualifying a rotorcraft FFS. The sponsor should also consult the objective tests in Appendix B2 and functions and subjective tests listed in Appendix B3 of this to determine the complete requirements for an aeroplane specific level simulator.
2. The material contained in this Appendix is divided into the following categories:
 - a. General flight deck configuration.
 - b. Simulator programming.
 - c. Equipment operation.
 - d. Equipment and facilities for instructor/evaluator functions.
 - e. Motion system.
 - f. Visual system.
 - g. Sound system.
3. Table B1A provides the standards for the General Simulator Requirements.
4. Table B1B provides the tasks that the sponsor will examine to determine whether the FFS satisfactorily meets the requirements for flight crew training, testing, and experience, and provides the tasks for which the simulator may be qualified.
5. Table B1C provides the functions that an instructor/check pilot must be able to control in the simulator.
6. It is not required that all of the tasks that appear on the List of Qualified Tasks (part of the SOQ) be accomplished during the initial or continuing qualification evaluation.

Table B1A –Rotorcraft - Minimum Simulator Requirements

Table B1A –Rotorcraft - Minimum Simulator Requirements						
Entry No.	General Simulator Requirements	Simulator Level			Notes	
		B	C	D		
1. GENERAL FLIGHT DECK CONFIGURATION						
1.a	The simulator must have a flight deck that is a replica of the rotorcraft being simulated. The simulator must have controls, equipment, observable flight deck indicators, circuit breakers, and bulkheads properly located, functionally accurate and replicating the rotorcraft. The direction of movement of controls and switches must be identical to that in the rotorcraft. Pilot seats must afford the capability for the occupant to be able to achieve the design “eye position” established for the rotorcraft being simulated. Equipment for the operation of the flight deck windows must be included, but the actual windows need not be operable. Fire axes, extinguishers, and spare light bulbs must be available in the FFS but may be relocated to a suitable location as near as practical to the original position. Fire axes, landing gear pins, and any similar purpose instruments need only be represented in silhouette.	X	X	X	For simulator purposes, the flight deck consists of all that space forward of a cross section of the fuselage at the most extreme aft setting of the pilots' seats including additional, required flight crewmember duty stations and those required bulkheads aft of the pilot seats. For clarification, bulkheads containing only items such as landing gear pin storage compartments, fire axes and extinguishers, spare light bulbs, and aircraft documents pouches are not considered essential and may be omitted.	
1.b	Those circuit breakers that affect procedures or result in observable flight deck indications must be properly located and functionally accurate.	X	X	X		
2. PROGRAMMING.						
2.a	A flight dynamics model that accounts for various combinations of air speed and power normally encountered in flight must correspond to actual flight conditions, including the effect of change in rotorcraft attitude, aerodynamic and propulsive forces and moments, altitude, temperature, mass, center of gravity location, and configuration. An SOC is required.	X	X	X		
2.b	The simulator must have the computer capacity, accuracy, resolution, and dynamic response needed to meet the qualification level sought. An SOC is required.	X	X	X		

Table B1A –Rotorcraft - Minimum Simulator Requirements

Entry No.	General Simulator Requirements	Simulator Level			Notes
		B	C	D	
2.c	Ground handling (where appropriate) and aerodynamic programming must include the following:				
2.c.1	Ground effect. Level B does not require hover programming. An SOC is required.	X	X	X	Applicable areas include flare and touch down from a running landing as well as for in-ground-effect (IGE) hover. A reasonable simulation of ground effect includes modeling of lift, drag, pitching moment, trim, and power while in ground effect.
2.c.2	Ground reaction. Level B does not require hover programming. An SOC is required.	X	X	X	Reaction of the rotorcraft upon contact with the landing surface during landing (e.g., strut deflection, tire skid friction, or side forces) may differ with changes in gross weight, airspeed, rate of descent on touchdown, and slide slip.
2.d	The simulator must provide for manual and automatic testing of simulator hardware and software programming to determine compliance with simulator objective tests as prescribed in Attachment 2 of this appendix. An SOC is required.		X	X	
2.e	Latency Tests or Transport Delay. The relative responses of the motion system, visual system, and flight deck instruments must be measured by latency tests or transport delay tests. Motion onset must occur before the end of the scan of that video field. Instrument response may not occur prior to motion onset. Test results must be within the following limits: Note: The intent is to verify that the simulator provides instrument, motion, and visual cues that are like the rotorcraft responses within the stated time delays. It is preferable motion onset occur before the start of the visual scene change (the start of the scan of the first video field containing different information). For rotorcraft response, acceleration in the appropriate corresponding rotational axis is preferred.				
2.e.1	Response must be within 150 milliseconds of the rotorcraft response.	X			
2.e.2	Response must be within 100 milliseconds of the rotorcraft response.		X	X	
2.f	The simulator must simulate brake and tire failure dynamics (including antiskid failure, if appropriate). An SOC is required.		X	X	The simulator should represent the motion (in the appropriate axes) and the directional control characteristics of the rotorcraft when experiencing simulated brake or tire failures.

Table B1A –Rotorcraft - Minimum Simulator Requirements

Entry No.	General Simulator Requirements	Simulator Level			Notes
		B	C	D	
2.g	The aerodynamic modeling in the simulator must include: (1) Ground effect, (2) Effects of airframe and rotor icing (if applicable), (3) Aerodynamic interference effects between the rotor wake and fuselage, (4) Influence of the rotor on control and stabilization systems, (5) Representations of settling with power, and (6) Retreating blade stall. An SOC is required.		X	X	
2.h	The simulator must provide for realistic mass properties, including gross weight, center of gravity, and moments of inertia as a function of payload and fuel loading An SOC is required.		X	X	
3. EQUIPMENT OPERATION.					
3.a	All relevant instrument indications involved in the simulation of the rotorcraft must automatically respond to control movement or external disturbances to the simulated rotorcraft; e.g., turbulence or windshear. Numerical values must be presented in the appropriate units.	X	X	X	
3.b	Communications, navigation, caution, and warning equipment must be installed and operate within the tolerances applicable for the rotorcraft being simulated.	X	X	X	See Attachment 3 of this appendix for further information regarding long-range navigation equipment.
3.c	Simulated rotorcraft systems must operate as the rotorcraft systems operate under normal, abnormal, and emergency operating conditions on the ground and in flight.	X	X	X	
3.d	The simulator must provide pilot controls with control forces and control travel that correspond to the simulated rotorcraft. The simulator must also react in the same manner as the rotorcraft under the same flight conditions.	X	X	X	

Table B1A –Rotorcraft - Minimum Simulator Requirements

Entry No.	General Simulator Requirements	Simulator Level			Notes
		B	C	D	
3.e	Simulator control feel dynamics must replicate the rotorcraft simulated. This must be determined by comparing a recording of the control feel dynamics of the simulator to rotorcraft measurements. For initial and upgrade evaluations, the control dynamic characteristics must be measured and recorded directly from the flight deck controls, and must be accomplished in takeoff, cruise, and landing conditions and configurations.		X	X	
4. INSTRUCTOR / EVALUATOR FACILITIES.					
4.a	In addition to the flight crewmember stations, the simulator must have at least two suitable seats for the instructor/check airman and FAA inspector. These seats must provide adequate vision to the pilot's panel and forward windows. All seats other than flight crew seats need not represent those found in the rotorcraft but must be adequately secured to the floor and equipped with similar positive restraint devices.	X	X	X	The MSP will consider alternatives to this standard for additional seats based on unique flight deck configurations
4.b	The simulator must have controls that enable the instructor/evaluator to control all required system variables and insert all abnormal or emergency conditions into the simulated rotorcraft systems as described in the sponsor's FAA-approved training program, or as described in the relevant operating manual as appropriate.	X	X	X	
4.c	The simulator must have instructor controls for all environmental effects expected to be available at the IOS; e.g., clouds, visibility, icing, precipitation, temperature, storm cells, and wind speed and direction.	X	X	X	
4.d	The simulator must provide the instructor or evaluator the ability to present ground and air hazards.		X	X	For example, another aircraft crossing the active runway and converging airborne traffic.
4.e	The simulator must provide the instructor or evaluator the ability to present the effect of re-circulating dust, water vapor, or snow conditions that develop as a result of rotor downwash.		X	X	This is a selectable condition that is not required for all operations on or near the surface.
5. MOTION SYSTEM.					
5.a	The simulator must have motion (force) cues perceptible to the pilot that are representative of the motion in a rotorcraft.	X	X	X	For example, touchdown cues should be a function of the rate of descent (RoD) of the simulated rotorcraft.

Table B1A –Rotorcraft - Minimum Simulator Requirements

Entry No.	General Simulator Requirements	Simulator Level			Notes
		B	C	D	
5.b	The simulator must have a motion (force cueing) system with a minimum of three degrees of freedom (at least pitch, roll, and heave). An SOC is required.	X			
5.c	The simulator must have a motion (force cueing) system that produces cues at least equivalent to those of a six-degrees-of-freedom, synergistic platform motion system (i.e., pitch, roll, yaw, heave, sway, and surge). An SOC is required.		X	X	
5.d	The simulator must provide for the recording of the motion system response time. An SOC is required.	X	X	X	
5.e	The simulator must provide motion effects programming to include the following:				
5.e	(1) Runway rumble, oleo deflections, effects of ground speed, uneven runway, characteristics. (2) Buffets due to transverse flow effects. (3) Buffet during extension and retraction of landing gear. (4) Buffet due to retreating blade stall. (5) Buffet due to vortex ring (settling with power). (6) Representative cues resulting from touchdown. (7) High speed rotor vibrations.	X	X	X	
	(8) Tire failure dynamics. (9) Engine malfunction and engine damage. (10) Airframe ground strike.		X	X	
	(11) Motion vibrations that result from atmospheric disturbances.			X	For air turbulence, general purpose disturbance models are acceptable if, when used, they produce test results that approximate demonstrable flight test data.

Table B1A –Rotorcraft - Minimum Simulator Requirements

Entry No.	General Simulator Requirements	Simulator Level			Notes
		B	C	D	
5.f	The simulator must provide characteristic motion vibrations that result from operation of the rotorcraft (for example, retreating blade stall, extended landing gear, settling with power) in so far as vibration marks an event or rotorcraft state, which can be sensed in the flight deck.			X	The simulator should be programmed and instrumented in such a manner that the characteristic buffet modes can be measured and compared to rotorcraft data.
6. VISUAL SYSTEM. Note: Additional horizontal field-of-view capability may be added at the sponsor's discretion provided the minimum field-of-view is retained.					
6.a	The simulator must have a visual system providing an out-of-the-flight deck view.	X	X	X	None
6.b	The simulator must provide a continuous field-of-view of at least 75° horizontally and 30° vertically per pilot seat. Both pilot seat visual systems must be operable simultaneously. The minimum horizontal field-of-view coverage must be plus and minus one-half ($\frac{1}{2}$) of the minimum continuous field-of-view requirement, centered on the zero degree azimuth line relative to the aircraft fuselage. An SOC must explain the geometry of the installation. An SOC is required.	X			

Table B1A –Rotorcraft - Minimum Simulator Requirements

Entry No.	General Simulator Requirements	Simulator Level			Notes
		B	C	D	
6.c	The simulator must provide a continuous visual field-of-view of at least 146° horizontally and 36° vertically per pilot seat. Both pilot seat visual systems must be operable simultaneously. Horizontal field-of-view is centered on the zero degree azimuth line relative to the aircraft fuselage. The minimum horizontal field-of-view coverage must be plus and minus one-half (½) of the minimum continuous field-of-view requirement, centered on the zero degree azimuth line relative to the aircraft fuselage. An SOC must explain the geometry of the installation. Capability for a field-of-view in excess of the minimum is not required for qualification at Level C. However, where specific tasks require extended fields of view beyond the 146° by 36° (e.g., to accommodate the use of “chin windows” where the accommodation is either integral with or separate from the primary visual system display), then the extended fields of view must be provided. When considering the installation and use of augmented fields of view, the sponsor must meet with the MSP to determine the training, testing, checking, and experience tasks for which the augmented field-of-view capability may be required. An SOC is required.		X		Optimization of the vertical field-of-view may be considered with respect to the specific rotorcraft flight deck cut-off angle. The sponsor may request the MSP to evaluate the FFS for specific authorization(s) for the following: (1) Specific areas within the database needing higher resolution to support landings, take-offs and ground cushion exercises and training away from a heliport, including elevated heliport, helidecks and confined areas. (2) For cross-country flights, sufficient scene details to allow for ground to map navigation over a sector length equal to 30 minutes at an average cruise speed. (3) For offshore airborne radar approaches (ARA), harmonized visual/radar representations of installations.

Table B1A –Rotorcraft - Minimum Simulator Requirements

Entry No.	General Simulator Requirements	Simulator Level			Notes
		B	C	D	
6.d	The simulator must provide a continuous visual field-of-view of at least 176° horizontally and 56° vertically per pilot seat. Both pilot seat visual systems must be operable simultaneously. Horizontal field-of-view is centered on the zero degree azimuth line relative to the aircraft fuselage. The minimum horizontal field-of-view coverage must be plus and minus one-half (½) of the minimum continuous field-of-view requirement, centered on the zero degree azimuth line relative to the aircraft fuselage. An SOC must explain the geometry of the installation. Capability for a field-of-view in excess of the minimum is not required for qualification at Level D. However, where specific tasks require extended fields of view beyond the 176° by 56° (e.g., to accommodate the use of “chin windows” where the accommodation is either integral with or separate from the primary visual system display), then the extended fields of view must be provided. When considering the installation and use of augmented fields of view, the sponsor must meet with the MSP to determine the training, testing, checking, and experience tasks for which the augmented field-of-view capability may be required. An SOC is required.			X	See above (as per 6.e)
6.e	The visual system must be free from optical discontinuities and artifacts that create non-realistic cues.	X	X	X	Non-realistic cues might include image “swimming” and image “roll-off,” that may lead a pilot to make incorrect assessments of speed, acceleration and/or situational awareness.
6.f	The simulator must have operational landing lights for night scenes. Where used, dusk (or twilight) scenes require operational landing lights.	X	X	X	
6.g	The simulator must have instructor controls for the following: (1) Visibility in statute miles (kilometers) and runway visual range (RVR) in ft. (meters). (2) Airport or landing area selection. (3) Airport or landing area lighting.	X	X	X	

Table B1A –Rotorcraft - Minimum Simulator Requirements

Entry No.	General Simulator Requirements	Simulator Level			Notes
		B	C	D	
6.h	Each airport scene displayed must include the following: (1) Airport runways and taxiways. (2) Runway definition: (a) Runway surface and markings. (b) Lighting for the runway in use, including runway threshold, edge, centerline, touchdown zone, VASI (or PAPI), and approach lighting of appropriate colors, as appropriate. (c) Taxiway lights.	X	X	X	
6.i	The simulator must provide visual system compatibility with dynamic response programming.	X	X	X	
6.j	The simulator must show that the segment of the ground visible from the simulator flight deck is the same as from the rotorcraft flight deck (within established tolerances) when at the correct airspeed and altitude above the touchdown zone.	X	X	X	This will show the modeling accuracy of the scene with respect to a pre-determined position from the end of the runway "in use."
6.k	The simulator must provide visual cues necessary to assess rate of change of height, height AGL, and translational displacement and rates during takeoffs and landings.	X			
6.l	The simulator must provide visual cues necessary to assess rate of change of height, height AGL, as well as translational displacement and rates during takeoff, low altitude/low airspeed maneuvering, hover, and landing.		X	X	
6.m	The simulator must provide for accurate portrayal of the visual environment relating to the simulator attitude.	X	X	X	Visual attitude vs. simulator 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
6.n	The simulator must provide for quick confirmation of visual system color, RVR, focus, and intensity. An SOC is required.		X	X	
6.o	The simulator must be capable of producing at least 10 levels of occulting.		X	X	

Table B1A –Rotorcraft - Minimum Simulator Requirements

Entry No.	General Simulator Requirements	Simulator Level			Notes
		B	C	D	
6.p	Night Visual Scenes. The simulator must provide night visual scenes with sufficient scene content to recognize the airport, the terrain, and major landmarks around the airport. The scene content must allow a pilot to successfully accomplish a visual landing. Night scenes, as a minimum, must provide presentations of sufficient surfaces with appropriate textural cues that include self-illuminated objects such as road networks, ramp lighting, and airport signage, to conduct a visual approach, a landing, and airport movement (taxi). Scenes must include a definable horizon and typical terrain characteristics such as fields, roads and bodies of water and surfaces illuminated by rotorcraft landing lights.	X	X	X	
6.q	Dusk (Twilight) Visual Scenes. The simulator must provide dusk (or twilight) visual scenes with sufficient scene content to recognize the airport, the terrain, and major landmarks around the airport. The scene content must allow a pilot to successfully accomplish a visual landing. Dusk (or twilight) scenes, as a minimum, must provide full color presentations of reduced ambient intensity, sufficient surfaces with appropriate textural cues that include self-illuminated objects such as road networks, ramp lighting and airport signage, to conduct a visual approach, landing and airport movement (taxi). Scenes must include a definable horizon and typical terrain characteristics such as fields, roads and bodies of water and surfaces illuminated by representative aircraft lighting (e.g., landing lights). If provided, directional horizon lighting must have correct orientation and be consistent with surface shading effects. Total scene content must be comparable in detail to that produced by 10,000 visible textured surfaces and 15,000 visible lights with sufficient system capacity to display 16 simultaneously moving objects. An SOC is required.		X	X	
6.r	Daylight Visual Scenes. The simulator must have daylight visual scenes with sufficient scene content to recognize the airport, the terrain, and major landmarks around the airport. The scene content must allow a pilot to successfully accomplish a visual landing. No ambient lighting may “washout” the displayed visual scene. Total scene content must be comparable in detail to that produced by 10,000 visible textured surfaces and 6,000 visible lights with sufficient system capacity to display 16 simultaneously moving objects. The visual display must be free of apparent and distracting quantization and other distracting visual effects while the simulator is in motion. An SOC is required.		X	X	
6.s	The simulator must provide operational visual scenes that portray physical relationships known to cause landing illusions to pilots.		X	X	For example: short runways, landing approaches over water, uphill or downhill runways, rising terrain on the approach path, unique topographic features.

Table B1A –Rotorcraft - Minimum Simulator Requirements

Entry No.	General Simulator Requirements	Simulator Level			Notes
		B	C	D	
6.t	The simulator must provide special weather representations of light, medium, and heavy precipitation near a thunderstorm on takeoff and during approach and landing. Representations need only be presented at and below an altitude of 2,000 ft. (610 m) above the airport surface and within 10 miles (16 km) of the airport.		X	X	
6.u	The simulator must present visual scenes of wet and snow-covered runways, including runway lighting reflections for wet conditions, and partially obscured lights for snow conditions.		X	X	The MSP will consider suitable alternative effects.
6.v	The simulator must present realistic color and directionality of all airport lighting.		X	X	
7. SOUND SYSTEM.					
7.a	The simulator must provide flight deck sounds that result from pilot actions that correspond to those that occur in the rotorcraft.	X	X	X	
7.b	Volume control, if installed, must have an indication of the sound level setting.	X	X	X	
7.c	The simulator must accurately simulate the sound of precipitation, windshield wipers, and other significant rotorcraft noises perceptible to the pilot during normal and abnormal operations, and include the sound of a crash (when the simulator is landed in an unusual attitude or in excess of the structural gear limitations); normal engine sounds; and the sounds of gear extension and retraction. An SOC is required.		X	X	
7.d	The simulator must provide realistic amplitude and frequency of flight deck noises and sounds. Simulator performance must be recorded, compared to amplitude and frequency of the same sounds recorded in the rotorcraft, and made a part of the QTG.			X	

Table B1B - Rotorcraft - Tasks vs Simulator Level –Subjective Requirements

Table B1B - Rotorcraft - Tasks vs Simulator Level –Subjective Requirements					
QPS Requirements					
Entry #	Subjective Requirements In order to be qualified at the FFS level indicated by the (X), the simulator must be able to perform at least the tasks indicated herein.	Simulator Levels			
		B	C	D	
1. PRE-FLIGHT PROCEDURES.					
1.a	Pre-flight Inspection (Flight deck Only) switches, indicators, systems, and equipment.	X	X	X	
1.b	APU/Engine start and run-up.				
1.b.1	• Normal start procedures.	X	X	X	
1.b.2	• Alternate start procedures.	X	X	X	
1.b.3	• Abnormal starts and shutdowns (hot start, hung start).	X	X	X	
1.c	Taxiing – Ground.	X	X	X	
1.d	Taxiing – Hover.	X	X	X	
1.e	Pre-takeoff Checks.	X	X	X	
2. TAKEOFF AND DEPARTURE PHASE.					
2.a	Normal takeoff.				
2.a.1	• From ground.	X	X	X	
2.a.2	• From hover.		X	X	
2.a.3	• Running.	X	X	X	
2.b	Instrument.	X	X	X	
2.c	Powerplant Failure During Takeoff.	X	X	X	
2.d	Rejected Takeoff.	X	X	X	
2.e	Instrument Departure.	X	X	X	
3. CLIMB					
3.a	Normal.	X	X	X	
3.b	Obstacle clearance.	X	X	X	
3.c	Vertical.	X	X	X	
3.d	One engine inoperative.	X	X	X	
4. IN-FLIGHT MANEUVERS.					
4.a	Turns (timed, normal, steep).	X	X	X	
4.b	Powerplant Failure - Multiengine Rotorcrafts.	X	X	X	
4.c	Powerplant Failure - Single-Engine Rotorcrafts.	X	X	X	
4.d	Recovery From Unusual Attitudes.	X	X	X	
4.e	Settling with Power.	X	X	X	
4.f	Specific Flight Characteristics incorporated into the user's FAA approved flight training program. <i>Note: The system, task, or procedure may be examined if the appropriate rotorcraft system or control is simulated in the FSTD and is working properly.</i>	X	X	X	
5. INSTRUMENT PROCEDURES					
5.a	Instrument Arrival.	X	X	X	
5.b	Holding.	X	X	X	
5.c	Precision Instrument Approach:				
5.c.1	• Normal - All engines operating.	X	X	X	
5.c.2	• Manually controlled - One or more engines inoperative.	X	X	X	
5.d	Non-precision Instrument Approach.	X	X	X	
5.e	Missed Approach:				
5.e.1	• All engines operating.	X	X	X	
5.e.2	• One or more engines inoperative.	X	X	X	
5.e.3	• Stability augmentation system failure.	X	X	X	

Table B1B - Rotorcraft - Tasks vs Simulator Level –Subjective Requirements				
QPS Requirements				
Entry #	Subjective Requirements In order to be qualified at the FFS level indicated by the (X), the simulator must be able to perform at least the tasks indicated herein.	Simulator Levels		
		B	C	D
6. LANDINGS AND APPROACHES TO LANDINGS.				
6.a	Visual Approaches (normal, steep, shallow).	X	X	X
6.b	Landings:			
6.b.1	Normal/crosswind.			
6.b.1.a	○ Running.	X	X	X
6.b.1.b	○ From Hover.		X	X
6.b.2	• One or more engines inoperative.	X	X	X
6.b.3	• Rejected Landing.	X	X	X
7. NORMAL AND ABNORMAL PROCEDURES.				
7.a	Powerplant.	X	X	X
7.b	Fuel System.	X	X	X
7.c	Electrical System.	X	X	X
7.d	Hydraulic System.	X	X	X
7.e	Environmental System(s).	X	X	X
7.f	Fire Detection and Extinguisher Systems.	X	X	X
7.g	Navigation and Aviation Systems.	X	X	X
7.h	Automatic Flight Control System, Electronic Flight Instrument System, and Related Subsystems.	X	X	X
7.i	Flight Control Systems.	X	X	X
7.j	Anti-ice and Deice Systems.	X	X	X
7.k	Aircraft and Personal Emergency Equipment.	X	X	X
7.l	Special Missions tasks (e.g., Night Vision goggles, Forward Looking Infrared System, External Loads and as listed on the SOQ.) <i>Note: For Level B and C - The system, task, or procedure may be examined if the appropriate rotorcraft system or control is simulated in the FSTD and is working properly.</i>	X	X	X
8. EMERGENCY PROCEDURES (as applicable)				
8.a	Emergency Descent.	X	X	X
8.b	Inflight Fire and Smoke Removal.	X	X	X
8.c	Emergency Evacuation.	X	X	X
8.d	Ditching.	X	X	X
8.e	Autorotation Landing.	X	X	X
8.f	Retreating blade stall recovery.	X	X	X
8.g	Mast bumping.	X	X	X
8.h	Loss of tail rotor effectiveness.	X	X	X
8.i	Vortex recovery	X	X	X
8. POST-FLIGHT PROCEDURES				
9.a	After-Landing Procedures.	X	X	X
9.b	Parking and Securing.			
9.b.1	• Rotor brake operation.	X	X	X
9.b.2	• Abnormal/emergency procedures.	X	X	X

Table B1C – Rotorcraft - Table of Simulator System Tasks – Subjective Requirements

Table B1C – Rotorcraft - Table of Simulator System Tasks – Subjective Requirements				
QPS REQUIREMENTS				
Entry #	Subjective Requirements In order to be qualified at the FFS level indicated by the (X), the simulator must be able to perform at least the tasks indicated herein.	Simulator Levels		
		B	C	D
1. INSTRUCTOR OPERATING STATION (IOS), as appropriate.				
1.a.	Power switch (es).	X	X	X
1.b.	Rotorcraft conditions (e.g., GW, CG, Fuel loading and Systems.)	X	X	X
1.c.	Airports / Runway. (e.g., Selection, Surface, Pre-sets, Lighting controls.)	X	X	X
1.d.	Environmental controls (e.g., Clouds, Visibility, RVR, Temp, Wind, Ice, Snow, Rain, and Windshear. Appropriate defaults for nominal flight conditions on system boot up.)	X	X	X
1.e.	Aeroplane system malfunctions (insertion / deletion)	X	X	X
1.f.	Locks, Freezes, and Repositioning	X	X	X
2. SOUND CONTROLS.				
2.a.	On / Off / adjustment	X	X	X
3. MOTION / CONTROL LOADING SYSTEM.				
3.a.	On / Off / emergency stop	X	X	X
4. OBSERVER SEATS / STATIONS				
4.a	Position / Adjustment / Position restraint system.	X	X	X

Appendix B2 – Rotorcraft FFS - Objective Tests

Introduction

1. If relevant winds are present in the objective data, the wind vector (magnitude and direction) should be clearly noted as part of the data presentation, expressed in conventional terminology, and related to the runway being used for the test.
2. The MSP will not evaluate any simulator unless the required SOC indicates that the motion system is designed and manufactured to safely operate within the simulator's maximum excursion, acceleration, and velocity capabilities (see Motion System in Table of B2A).
3. Table B2A addresses rotorcraft simulators at Levels B, C, and D because there are no Level-A Rotorcraft simulators.

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS								INFORMATION	
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes	
Entry #	Title				B	C	D		
1. PERFORMANCE									
1.a.	Engine Assessment								
1.a.1	Start Operations								
1.a.1.a	Engine start and acceleration (transient).	Light Off Time - ±10% or ±1 sec., Torque - ±5%, Rotor Speed - ±3%, Fuel Flow - ±10%, Gas Generator Speed - ±5%, Power Turbine Speed - ±5%, Gas Turbine Temp. - ±30°C	Ground with: Rotor Brake Used and Rotor Brake Not Used, If applicable.	Record each engine start from the initiation of the start sequence to steady state idle and from steady state idle to operating RPM.	X	X	X		
1.a.1.b	Steady State Idle and Operating	Torque - ±3%, Rotor Speed - ±1.5%, Fuel Flow - ±5%,	Ground	Record both steady state idle and operating RPM conditions. May be a series of snapshot tests.	X	X	X		

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
	RPM conditions.	Gas Generator Speed - ±2%, Power Turbine Speed - ±2%, Turbine Gas Temp. - ±20°C.						
1.a.2	Power Turbine Speed Trim	±10% of total change of power turbine speed, or ±0.5% change of rotor speed.	Ground	Record engine response to trim system actuation in both directions.	X	X	X	
1.a.3	Engine and Rotor Speed Governing	Torque - ±5%, Rotor Speed - 1.5%.	Climb and descent	Record results using a step input to the collective. May be conducted concurrently with climb and descent performance tests.	X	X	X	
1.b	Surface Operations							

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
1.b.1	Minimum Radius Turn	±3 ft. (0.9m) or 20% of rotorcraft turn radius.	Ground	If brakes are used, brake pedal position and brake system pressure must be matched to the rotorcraft flight test value.	X	X	X	
1.b.2	Rate of Turn vs. Pedal Deflection, Brake Application, or Nosewheel Angle, as applicable	±10% or ±2°/sec. Turn Rate.	Ground Takeoff	If brakes are used, brake pedal position and brake system pressure must be matched to the rotorcraft flight test value.	X	X	X	
1.b.3	Taxi	Pitch Angle - ±1.5°, Torque - ±3%, Longitudinal Control Position - ±5%, Lateral Control Position - ±5%, Directional Control Position ±5%, Collective Control Position - ±5%	Ground	Record results for control position and pitch attitude during ground taxi for a specific ground speed, wind speed and direction, and density altitude.	X	X	X	
1.b.4	Brake Effectiveness	±10% of time and distance.	Ground		X	X	X	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION	
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes	
Entry #	Title				B	C	D		
1.c.	Takeoff: When the speed range for the following tests is < 40 knots, the applicable airspeed tolerance may be applied to either airspeed or ground speed, as appropriate.								
1.c.1	All Engines	Airspeed - ±3 kt, Altitude - ±20 ft (6.1m), Torque - ±3%, Rotor Speed - ±1.5%, Vertical Velocity - ±1	Ground / Takeoff and	Record results of takeoff flight path as appropriate to rotorcraft model simulated (running takeoff for Level B, takeoff from a hover for Level C and D). For Level B, the criteria apply only to those segments at airspeeds above effective translational lift. Results must be recorded from	X	X	X		

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
		00 fpm (0.50m/sec) or 10%, Pitch Attitude - $\pm 1.5^\circ$, Bank Attitude - $\pm 2^\circ$, Heading - $\pm 2^\circ$, Longitudinal Control Position - $\pm 10\%$, Lateral Control Position - $\pm 10\%$, Directional Control Position - $\pm 10\%$, Collective Control Position - $\pm 10\%$.	Initial Segment of Climb.	the initiation of the takeoff to at least 200 ft (61m) AGL.				
1.c.2	One Engine Inoperative continued takeoff.	Airspeed - ± 3 kt, Altitude - ± 20 ft (6.1m), Torque - $\pm 3\%$, Rotor Speed - $\pm 1.5\%$, Vertical Velocity - ± 100 fpm (0.50m/sec) or 10%, Pitch Attitude - $\pm 1.5^\circ$,	Ground/ Takeoff; And Initial Segment of Climb.	Record takeoff flight path as appropriate to rotorcraft model simulated. Results must be recorded from the initiation of the takeoff to at least 200 ft (61m) AGL.	X	X	X	Because several kinds of takeoff procedures can be performed, the specific type of takeoff profile should be recorded to ensure the proper takeoff profile comparison test is used.

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
		Bank Attitude - $\pm 2^\circ$, Heading - $\pm 2^\circ$, Longitudinal Control Position - $\pm 10\%$ Lateral Control Position - $\pm 10\%$, Directional Control Position - $\pm 10\%$, Collective Control Position - $\pm 10\%$.						
1.c.3	One Engine inoperative, rejected take off.	Airspeed ± 3 kt Altitude ± 20 ft (6.1m) Torque $\pm 3\%$ Rotor Speed $\pm 1.5\%$ Pitch Attitude $\pm 1.5^\circ$ Roll angle $\pm 1.5^\circ$; Heading $\pm 2^\circ$ Longitudinal Control Position $\pm 10\%$ Lateral Control Position $\pm 10\%$	Ground, Takeoff.	Time history from the take off point to touch down. Test conditions near limiting performance.		X	X	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
		Directional Control Position $\pm 10\%$ Collective Control Position $\pm 10\%$ Distance: $\pm 7.5\%$ or $\pm 30\text{m}$ (100ft).						
1.d	Hover Performance	Torque - $\pm 3\%$, Pitch Attitude - $\pm 1.5^\circ$, Bank Attitude - $\pm 1.5^\circ$, Longitudinal Control Position - $\pm 5\%$, Lateral Control Position - $\pm 5\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$.	In Ground Effect (IGE); and Out of Ground Effect (OGE).	Record results for light and heavy gross weights. May be a series of snapshot tests.		X	X	
1.e.	Vertical Climb Performance	Vertical Velocity - ± 100 fpm (0.50 m/sec) or $\pm 10\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$.	From OGE Hover.	Record results for light and heavy gross weights. May be a series of snapshot tests.		X	X	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
1.f.	Level Flight Performance and Trimmed Flight Control Positions.	Torque - $\pm 3\%$, Pitch Attitude - $\pm 1.5^\circ$, Sideslip Angle - $\pm 2^\circ$, Longitudinal Control Position - $\pm 5\%$, Lateral Control Pos'n - $\pm 5\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$.	Cruise (Augmentation On and Off).	Record results for two gross weight and CG combinations with varying trim speeds throughout the airspeed envelope. May be a series of snapshot tests.	X	X	X	This test validates performance at speeds above maximum endurance airspeed

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
1.g.	Climb Performance and Trimmed Flight Control Positions.	Vertical Velocity - ± 100 fpm (6.1m/sec) or $\pm 10\%$, Pitch Attitude - $\pm 1.5^\circ$, Sideslip Angle - $\pm 2^\circ$, Longitudinal Control Position - $\pm 5\%$, Lateral Control Pos'n - $\pm 5\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$.	All engines operating; One engine inoperative; Augmentation System(s) On and Off.	Record results for two gross weight and CG combinations. The data presented must be for normal climb power conditions. May be a series of snapshot tests.	X	X	X	
1.h.	Descent :							
1.h.1	Descent Performance and Trimmed Flight Control Positions.	Torque - $\pm 3\%$, Pitch Attitude - $\pm 1.5^\circ$, Sideslip Angle - $\pm 2^\circ$ Longitudinal Control Position - $\pm 5\%$,	At or near 1,000 fpm (5 m/sec) rate of descent (RoD) at normal approach speed.	Results must be recorded for two gross weight and CG combinations. May be a series of snapshot tests.	X	X	X	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
		Lateral Control Pos'n - $\pm 5\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$.	Augmentation System(s) On and Off.					
1.h.2	Autorotation Performance and Trimmed Flight Control Positions.	Pitch Attitude - $\pm 1.5^\circ$, Sideslip Angle - $\pm 2^\circ$, Longitudinal Control Position - $\pm 5\%$, Lateral Control Position - $\pm 5\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$ Vertical Velocity ± 100 fpm or 10%, Rotor Speed $\pm 1.5\%$.	Steady descents. Augmentation System(s) On and Off.	Record results for two gross weight conditions. Data must be recorded for normal operating RPM. (Rotor speed tolerance applies only if collective control position is full down.) Data must be recorded for speeds from 50 kts, ± 5 kts, through at least maximum glide distance airspeed, or maximum allowable autorotation airspeed, whichever is slower. May be a series of snapshot tests.	X	X	X	
1.i.	Autorotation Entry.	Rotor Speed - $\pm 3\%$ Pitch Attitude $\pm 2^\circ$ Roll Attitude - $\pm 3^\circ$ Yaw Attitude - $\pm 5^\circ$ Airspeed - ± 5 kts.	Cruise or Climb.	Record results of a rapid throttle reduction to idle. If the cruise condition is selected, comparison must be made for the maximum range airspeed. If the climb condition is selected, comparison must be made for the maximum rate of climb airspeed at or near maximum continuous power.		X	X	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
		Vertical Velocity - ± 200 fpm (1.00 m/sec) or 10%.						
1.j.	Landing: When the speed range for tests 1.j.1., 1.j.2., or 1.j.3. is less than 40 knots, the applicable airspeed tolerance may be applied to either airspeed or ground speed, as appropriate.							
1.j.1	All Engines.	Airspeed - ± 3 kts. Altitude - ± 20 ft. (6.1m), Torque - $\pm 3\%$, Rotor Speed - $\pm 1.5\%$, Pitch Attitude - $\pm 1.5^\circ$, Bank Attitude - $\pm 1.5^\circ$, Heading - $\pm 2^\circ$, Longitudinal Control Position - $\pm 10\%$, Lateral Control Position - $\pm 10\%$, Directional Control Position - $\pm 10\%$, Collective Control Position - $\pm 10\%$.	Approach.	Record results of the approach and landing profile as appropriate to the rotorcraft model simulated (running landing for Level B, or approach to a hover for Level C and D). For Level B, the criteria apply only to those segments at airspeeds above effective translational lift.	X	X	X	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
1.j.2	One Engine Inoperative.	Airspeed - ± 3 kts. Altitude - ± 20 ft. (6.1m), Torque - $\pm 3\%$, Rotor Speed - $\pm 1.5\%$, Pitch Attitude - $\pm 1.5^\circ$, Bank Attitude - $\pm 1.5^\circ$, Heading - $\pm 2^\circ$, Longitudinal Control Position - $\pm 10\%$, Lateral Control Position - $\pm 10\%$, Directional Control Position - $\pm 10\%$, Collective Control Position - $\pm 10\%$.	Approach.	Record results for both Category A and Category B approaches and landing as appropriate to rotorcraft model simulated. For Level B, the criteria apply only to those segments at airspeeds above effective translational lift.	X	X	X	
1.j.3	Balked Landing	Airspeed - ± 3 kts, Altitude - ± 20 ft. (6.1m), Torque - $\pm 3\%$, Rotor Speed - $\pm 1.5\%$, Pitch Attitude - $\pm 1.5^\circ$,	Approach.	Record the results for the maneuver initiated from a stabilized approach at the landing decision point (LDP).	X	X	X	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
		Bank Attitude - $\pm 1.5^\circ$, Heading - $\pm 2^\circ$, Longitudinal Control Position - $\pm 10\%$, Lateral Control Position - $\pm 10\%$, Directional Control Position - $\pm 10\%$, Collective Control Position - $\pm 10\%$.						

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
1.j.4	Autorotational Landing.	Torque - $\pm 3\%$, Rotor Speed - $\pm 3\%$, Vertical Velocity - ± 100 fpm (0.50m/sec) or 10%, Pitch Attitude - $\pm 2^\circ$, Bank Attitude - $\pm 2^\circ$, Heading - $\pm 5^\circ$, Longitudinal Control Position - $\pm 10\%$, Lateral Control Position - $\pm 10\%$, Directional Control Position - $\pm 10\%$, Collective Control Position - $\pm 10\%$.	Landing.	Record the results of an autorotational deceleration and landing from a stabilized autorotational descent, to touch down. If flight test data containing all required parameters for a complete power-off landing is not available from the aircraft manufacturer for this test and other qualified flight test personnel are not available to acquire this data, the sponsor may coordinate with the MSP to determine if it is appropriate to accept alternative testing means.		X	X	Alternative approaches for acquiring this data may be acceptable, depending on the aircraft as well as the personnel and the data recording, reduction, and interpretation facilities to be used, are: 1) a simulated autorotational flare and reduction of rate of descent (ROD) at altitude; or 2) a power-on termination following an autorotational approach and flare.

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS								INFORMATION	
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes	
Entry #	Title				B	C	D		
2. HANDLING QUALITIES									
2.a	Control System Mechanical Characteristics								

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
	For simulators requiring Static or Dynamic tests at the controls (i.e., cyclic, collective, and pedal), special test fixtures will not be required during initial or upgrade evaluations if the sponsor's QTG/MQTG shows both test fixture results and the results of an alternative approach, such as computer plots produced concurrently showing satisfactory agreement. Repeat of the alternative method during the initial or upgrade evaluation satisfies this test requirement. For initial and upgrade evaluations, the control dynamic characteristics must be measured at and recorded directly from the flight deck controls, and must be accomplished in hover, climb, cruise, and autorotation.							
	Contact the MSP for clarification of any issue regarding rotorcrafts with reversible controls or where the required validation data is not attainable.							
2.a.1	Cyclic.	Breakout - ±0.25 lbs. (0.112 daN) or 25%; Force - ±1.0 lb. (0.224 daN) or 10%.	Ground; Static conditions with the hydraulic system (if applicable) pressurized; supplemental hydraulic pressurization system may be used. Trim On and Off. Friction Off Augmentation (if applicable) On and Off.	Record results for an uninterrupted control sweep to the stops. (This test does not apply if aircraft hardware modular controllers are used.)	X	X	X	Flight Test Data for this test does not require the rotor to be engaged/turning. The phrase “if applicable” regarding stability augmentation systems means if an augmentation system is available and if this system may be operational on the ground under static conditions as described here.
2.a.2	Collective / Pedals	Breakout - ±0.5 lb. (0.224 daN) or 25%;	As above	Record results for an uninterrupted control sweep to the stops.	X	X	X	Flight Test Data for this test does not require the rotor to be engaged/turning.

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
		Force - ± 1.0 lb. (0.224 daN) or 10%.						The phrase "if applicable" regarding stability augmentation system means if a stability augmentation system is available and if this system may be operational on the ground under static conditions as described here."
2.a.3	Brake Pedal Force vs. Position.	± 5 lbs. (2.224 daN) or 10%.	Ground; Static conditions.		X	X	X	
2.a.4	Trim System Rate (all applicable systems)	Rate - $\pm 10\%$.	Ground; Static conditions. Trim On, Friction Off.	The tolerance applies to the recorded value of the trim rate.	X	X	X	
2.a.5	Control Dynamics (all axes)	$\pm 10\%$ of time for first zero crossing and ± 10 (N+1) % of period thereafter, $\pm 10\%$ of amplitude of first overshoot, 20% of amplitude of 2nd and subsequent overshoots	Hover/Cruise Trim On, Friction Off.	Results must be recorded for a normal control displacement in both directions in each axis		X	X	Typically, control displacement of 25% to 50% is necessary for proper excitation. Control Dynamics for irreversible control systems may be evaluated in a ground/static condition.

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
		greater than 5% of initial displacement, ±1 overshoot.						Additional information on control dynamics is found in Section 4.7 of this Chapter. “N” is the sequential period of a full cycle of oscillation.
2.a.6	Control System Free play	±0.10 inches (±2.5 mm).	Ground; Static conditions; with the hydraulic system (if applicable) pressurized; supplemental hydraulic pressurization system may be used.	Record and compare results for all controls.	X	X	X	Flight Test Data for this test does not require the rotor to be engaged/turning.
2.b	Low Airspeed Handling Qualities							

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
2.b.1	Trimmed Flight Control Positions.	Torque - $\pm 3\%$ Pitch Attitude - $\pm 1.5^\circ$ Bank Attitude - $\pm 2^\circ$ Longitudinal Control Position - $\pm 5\%$. Lateral Control Position - $\pm 5\%$ Directional Control Position - $\pm 5\%$ Collective Control Position - $\pm 5\%$.	Translational Flight IGE – Sideward, rearward, and forward flight. Augmentation On and Off.	Record results for several airspeed increments to the translational airspeed limits and for 45 kts forward airspeed. May be a series of snapshot tests.		X	X	
2.b.2	Critical Azimuth	Torque - $\pm 3\%$ Pitch Attitude - $\pm 1.5^\circ$, Bank Attitude - $\pm 2^\circ$, Longitudinal Control Position - $\pm 5\%$, Lateral Control Position - $\pm 5\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$.	Stationary Hover. Augmentation On and Off.	Record results for three relative wind directions (including the most critical case) in the critical quadrant. May be a series of snapshot tests.		X	X	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
2.b.3	Control Response							
2.b.3.a	Longitudinal	Pitch Rate - $\pm 10\%$ or $\pm 2^\circ/\text{sec}$. Pitch Attitude Change - $\pm 10\%$ or 1.5° .	Hover. Augmentation On and Off.	Record results for a step control input. The Off-axis response must show correct trend for unaugmented cases.		X	X	This is a “short time” test conducted in a hover, in ground effect, without entering translational flight, to provide better visual reference.
2.b.3.b	Lateral	Roll Rate - $\pm 10\%$ or $\pm 3^\circ/\text{sec}$. Roll Attitude Change - $\pm 10\%$ or $\pm 3^\circ$.	Hover Augmentation On and Off.	Record results for a step control input. The Off-axis response must show correct trend for unaugmented cases.		X	X	This is a “short time” test conducted in a hover, in ground effect, without entering translational flight, to provide better visual reference.
2.b.3.c	Directional	Yaw Rate - $\pm 10\%$ or $\pm 2^\circ/\text{sec}$. Heading Change - $\pm 10\%$ or $\pm 2^\circ$.	Hover Augmentation On and Off.	Record results for a step control input. The Off-axis response must show correct trend for unaugmented cases.		X	X	This is a “short time” test conducted in a hover, in ground effect, without entering translational flight, to provide better visual reference.
2.b.3.d	Vertical	Normal Acceleration – ± 0.1 g.	Hover Augmentation On and Off.	Record results for a step control input. The Off-axis response must show correct trend for unaugmented cases.		X	X	
2.c.	Longitudinal Handling Qualities							

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
2.c.1	Control Response	Pitch Rate - $\pm 10\%$ or $\pm 2^\circ/\text{sec.}$, Pitch Attitude Change - $\pm 10\%$ or $\pm 1.5^\circ$.	Cruise Augmentation On and Off.	Results must be recorded for two cruise airspeeds to include minimum power required speed. Record data for a step control input. The Off-axis response must show correct trend for unaugmented cases.	X	X	X	
2.c.2	Static Stability	Longitudinal Control Position: $\pm 10\%$ of change from trim or ± 0.25 in. (6.3 mm) or Longitudinal Control Force: ± 0.5 lb. (0.223 daN) or $\pm 10\%$.	Cruise or Climb. Autorotation. Augmentation On and Off.	Record results for a minimum of two speeds on each side of the trim speed. May be a series of snapshot tests.	X	X	X	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests								
QPS REQUIREMENTS							INFORMATION	
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
2.c.3	Dynamic Stability							

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
2.c.3.a	Long Term Response.	±10% of calculated period, ±10% of time to ½ or double amplitude, or ±0.02 of damping ratio. For non-periodic responses, the time history must be matched within ±3° pitch; and ±5 kts airspeed over a 20 sec period following release of the controls.	Cruise Augmentation On and Off.	For periodic responses, record results for three full cycles (6 overshoots after input completed) or that sufficient to determine time to ½ or double amplitude, whichever is less. The test may be terminated prior to 20 sec. if the test pilot determines that the results are becoming uncontrollably divergent.	X	X	X	The response may be unrepeatable throughout the stated time for certain rotorcrafts. In these cases, the test should show at least that a divergence is identifiable. For example: displacing the cyclic for a given time normally excites this test or until a given pitch attitude is achieved and then return the cyclic to the original position. For non-periodic responses, results should show the same convergent or divergent character as the flight test data.
2.c.3.b	Short Term Response.	±1.5° Pitch or ±2°/sec. Pitch Rate. ±0.1 g Normal Acceleration.	Cruise or Climb. Augmentation On and Off.	Record results for at least two airspeeds.	X	X	X	A control doublet inserted at the natural frequency of the aircraft normally excites this test. However, while input doublets are preferred over pulse inputs for Augmentation-Off tests, for Augmentation-On tests, when the short term response exhibits 1st-order or deadbeat characteristics, longitudinal pulse inputs may

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
								produce a more coherent response.
2.c.4	Maneuvering Stability.	Longitudinal Control Position - $\pm 10\%$ of change from trim or ± 0.25 in. (6.3 mm) or Longitudinal Control Forces - ± 0.5 lb. (0.223 daN) or $\pm 10\%$.	Cruise or Climb. Augmentation On and Off.	Record results for at least two airspeeds at 30° - 45° roll angle. The force may be shown as a cross plot for irreversible systems. May be a series of snapshot tests.	X	X	X	
2.d	Lateral and Directional Handling Qualities							
2.d.1.a	Control Response Lateral	Roll Rate - $\pm 10\%$ or $\pm 3^\circ/\text{sec.}$, Roll Attitude Change - $\pm 10\%$ or $\pm 3^\circ$.	Cruise Augmentation On and Off.	Record results for at least two airspeeds, including the speed at or near the minimum power required airspeed. Record results for a step control input. The Off-axis response must show correct trend for unaugmented cases.	X	X	X	
2.d.1.b	Control Response Directional	Yaw Rate - $\pm 10\%$ or $\pm 2^\circ/\text{sec.}$, Yaw Attitude Change - $\pm 10\%$ or $\pm 2^\circ$.	Cruise Augmentation On and Off.	Record data for at least two airspeeds, including the speed at or near the minimum power required airspeed. Record results for a step control input. The Off-axis response must show correct trend for unaugmented cases.	X	X	X	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
2.d.2	Directional Static Stability	Lateral Control Position - $\pm 10\%$ of change from trim or ± 0.25 in. (6.3 mm) or Lateral Control Force - ± 0.5 lb. (0.223 daN) or 10%, Roll Attitude - ± 1.5 , Directional Control Position - $\pm 10\%$ of change from trim or ± 0.25 in. (6.3 mm) or Directional Control Force - ± 1 lb. (0.448 daN) or 10%, Longitudinal Control Position - $\pm 10\%$ of change from trim or ± 0.25 in. (6.3 mm) Vertical Velocity - ± 100 fpm (0.50m/sec) or 10%.	Cruise; or Climb (may use Descent instead of Climb if desired), Augmentation On and Off.	Record results for at least two sideslip angles on either side of the trim point. The force may be shown as a cross plot for irreversible systems. May be a series of snapshot tests.	X	X	X	This is a steady heading sideslip test at a fixed collective position

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
2.d.3	Dynamic Lateral and Directional Stability							
2.d.3.a	Lateral-Directional Oscillations	±0.5 sec. or ±10% of period, ±10% of time to ½ or double amplitude or ±0.02 of damping ratio, ±20% or ±1 sec of time difference between peaks of bank and sideslip. For non-periodic responses, the time history must be matched within ±10 knots Airspeed; ±5°/s Roll Rate or ±5° Roll Attitude; ±4°/s Yaw Rate or ±4° Yaw Angle over a 20 sec period roll angle following release of the controls.	Cruise or Climb. Augmentation On and Off.	Record results for at least two airspeeds. The test must be initiated with a cyclic or a pedal doublet input. Record results for six full cycles (12 overshoots after input completed) or that sufficient to determine time to ½ or double amplitude, whichever is less. The test may be terminated prior to 20 sec if the test pilot determines that the results are becoming uncontrollably divergent.	X	X	X	
2.d.3.b	Spiral Stability	±2° or ±10% roll angle.	Cruise or Climb. Augmentation On and Off.	Record the results of a release from pedal only or cyclic only turns for 20 sec. Results must be recorded from turns in both directions. Terminate check at zero roll angle or when the test pilot determines that the attitude is becoming uncontrollably divergent.	X	X	X	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS								INFORMATION	
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes	
Entry #	Title				B	C	D		
2.d.3.c	Adverse/ Proverse Yaw	Correct Trend, ±2° transient sideslip angle.	Cruise or Climb. Augmentation On and Off.	Record the time history of initial entry into cyclic only turns, using only a moderate rate for cyclic input. Results must be recorded for turns in both directions.	X	X	X		
3. MOTION SYSTEM									
3.a.	Frequency response	Based on Simulator Capability.	N/A	Required as part of the MQTG. The test must demonstrate frequency response of the motion system as specified by the applicant for flight simulator qualification.	X	X	X		
3.b.	Leg Balance	Based on Simulator Capability.	N/A	Required as part of the MQTG. The test must demonstrate motion system leg balance as specified by the applicant for flight simulator qualification.	X	X	X		

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS								INFORMATION	
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes	
Entry #	Title				B	C	D		
3.c.	Turn Around	Based on Simulator Capability.	N/A	Required as part of the MQTG. The test must demonstrate a smooth turn-around (shift to opposite direction of movement) of the motion system as specified by the applicant for flight simulator qualification.	X	X	X		
3.d	Motion system repeatability	With the same input signal, the test results must be repeatable to within ±0.05g actual platform linear acceleration in each axis.	Accomplished in both the “ground” mode and in the “flight” mode of the motion system operation.	Required as part of the MQTG. The test is accomplished by injecting a motion signal to generate movement of the platform. The input must be such that the rotational accelerations, rotational rates, and linear accelerations are inserted before the transfer from rotorcraft center of gravity to the pilot reference point with a minimum amplitude of 5°/sec/sec, 10°/sec and 0.3g, respectively.	X	X	X	See paragraph 4.9.3., of this Chapter for additional information. Note: if there is no difference in the model for “ground” and “flight” operation of the motion system, this should be described in an SOC and will not require tests in both modes.	
3.e.	Motion cueing performance signature Required as part of MQTG. These tests must be run with the motion buffet mode disabled. See paragraph 4.9.3., of this Chapter - Motion cueing performance signature.								
3.e.1	Takeoff (all engines).	As specified by the sponsor for flight simulator qualification.	Ground.	Pitch attitude due to initial climb must dominate over cab tilt due to longitudinal acceleration.	X	X	X	Associated to test number 1.c.1.	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
3.e.2	Hover performance (IGE and OGE).	As specified by the sponsor for flight simulator qualification.	Ground.			X	X	Associated to test number 1.d.
3.e.3	Autorotation (entry).	As specified by the sponsor for flight simulator qualification.	Flight.			X	X	Associated to test number 1.i.
3.e.4	Landing (all engines).	As specified by the sponsor for flight simulator qualification.	Flight.		X	X	X	Associated to test number 1.j.1.
3.e.5	Autorotation (landing).	As specified by the sponsor for flight simulator qualification.	Flight.			X	X	Associated to test number 1.j.4.
3.e.6	Control Response							
3.e.6.a	Longitudinal.	As specified by the sponsor for flight simulator qualification.	Flight.		X	X	X	Associated to test number 2.c.1.
3.e.6.b	Lateral.	As specified by the sponsor for flight simulator qualification.	Ground.		X	X	X	Associated to test number 2.d.1.a.

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
3.e.6.c	Directional.	As specified by the sponsor for flight simulator qualification.			X	X	X	Associated to test number 2.d.1.c.

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
3.f	Characteristic Motion (Vibration) Cues For all of the following tests, the simulator test results must exhibit the overall appearance and trends of the rotorcraft data, with at least three (3) of the predominant frequency “spikes” being present within ±2 Hz. Characteristic motion cues may be separate from the “main” motion system.							
3.f.1	Vibrations – to include 1/Rev and n/Rev vibrations (where “n” is the number of main rotor blades).	+3db to -6db or ±10% of nominal vibration level in flight-cruise and correct trend (see comment)	a) On ground (idle); b) In flight	Characteristic vibrations include those that result from operation of the rotorcraft (for example, high airspeed, retreating blade stall, extended landing gear, vortex ring or settling with power) in so far as vibration marks an event or rotorcraft state, which can be sensed in the flight deck. [See Table B1A, table entries 5.e. and 5.f.]			X	Correct trend refers to a comparison of vibration amplitudes between different maneuvers; e.g., if the 1/rev vibration amplitude in the rotorcraft is higher during steady state turns than in level flight this increasing trend should be demonstrated in the simulator. Additional examples of vibrations may include: a) Low & High speed transition to and from hover; b) Level flight; c) Climb and descent (including vertical climb; d) Auto-rotation; e) Steady Turns.

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
3.f.2	Buffet – Test against recorded results for characteristic buffet motion that can be sensed in the flight deck.	+3db to -6db or ±10% of nominal vibration level in flight-cruise and correct trend (see comment)	On ground and in flight.	Characteristic buffets include those that result from operation of the rotorcraft (for example, high airspeed, retreating blade stall, extended landing gear, vortex ring or settling with power) in so far as a buffet marks an event or rotorcraft state, which can be sensed in the flight deck. [See Table C1A, table entries 5.e. and 5.f.]			X	The recorded test results for characteristic buffets should allow the checking of relative amplitude for different frequencies. For atmospheric disturbance, general purpose models are acceptable which approximate demonstrable flight test data.
4. VISUAL SYSTEM								
4.a.	Visual System Response Time (Choose either test 4.a.1. or 4.a.2. to satisfy test 4.a., Visual System Response Time Test. This test is also sufficient for motion system response timing and flight deck instrument response timing.)							
4.a.1	Latency							
4.a.1	Latency	150 ms (or less) after rotorcraft response.	Takeoff, climb, and descent.	One test is required in each axis (pitch, roll and yaw) for each of the three conditions (take-off, cruise, and approach or landing).	X			

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
4.a.1	Latency	100 ms (or less) after rotorcraft response.	Climb, cruise, descent, and hover.	One test is required in each axis (pitch, roll and yaw) for each of the three conditions (take-off, cruise, and approach or landing).		X	X	
4.a.2	Transport Delay If Transport Delay is the chosen method to demonstrate relative responses, the sponsor and the MSP will use the latency values to ensure proper simulator response when reviewing those existing tests where latency can be identified (e.g., short period, roll response, rudder response).							
4.a.2	Transport Delay	150 ms (or less) after controller movement.	N/A	A separate test is required in each axis (pitch, roll, and yaw).	X			
4.a.2	Transport Delay	100 ms (or less) after controller movement.	N/A	A separate test is required in each axis (pitch, roll, and yaw).		X	X	
4.b.	Field-of-view							
4.b.1	Continuous field-of-view.	The simulator must provide a continuous field-of-view of at least 75° horizontally and 30° vertically per pilot seat or the number of degrees necessary to meet the visual ground segment requirement, whichever is greater. Both pilot seat visual systems must be operable simultaneously. Wide-angle systems providing cross-flight deck viewing (for both	N/A	An SOC is required and must explain the geometry of the installation. Additional horizontal field-of-view capability may be added at the sponsor's discretion provided the minimum field-of-view is retained.	X			Horizontal field-of-view is centered on the zero degree azimuth line relative to the aircraft fuselage. Field-of-view may be measured using a visual test pattern filling the entire visual scene (all channels) with a matrix of black and white 5° squares.

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
		pilots simultaneously) must provide a minimum field-of-view of at least 146° horizontally and 36° vertically. Any geometric error between the Image Generator eye point and the pilot eye point must be 8° or less.						
4.b.2	Continuous field-of-view.	The simulator must provide a continuous field-of-view of at least 146° horizontally and 36° vertically or the number of degrees necessary to meet the visual ground segment requirement, whichever is greater. The minimum horizontal field-of-view coverage must be plus and minus one-half (½) of the minimum continuous field-of-view requirement, centered on the zero degree azimuth line relative to the aircraft fuselage. Any geometric error between the Image Generator eye	N/A	An SOC is required and must explain the geometry of the installation. Horizontal field-of-view of at least 146° (including not less than 73° measured either side of the center of the design eye point). Additional horizontal field-of-view capability may be added at the sponsor's discretion provided the minimum field-of-view is retained. Vertical field-of-view of at least 36° measured from the pilot's and co-pilot's eye point.		X		Horizontal field-of-view is centered on the zero degree azimuth line relative to the aircraft fuselage. Field-of-view may be measured using a visual test pattern filling the entire visual scene (all channels) with a matrix of black and white 5° squares.

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
		point and the pilot eye point must be 8° or less.						
4.b.3	Continuous field-of-view.	Continuous field-of-view of at least 176° horizontal and 56° vertical field-of-view for each pilot simultaneously. Any geometric error between the Image Generator eye point and the pilot eye point must be 8° or less.	N/A	An SOC is required and must explain the geometry of the installation. Horizontal field-of-view is centered on the zero degree azimuth line relative to the aircraft fuselage. Horizontal field-of-view must be at least 176° (including not less than 88° either side of the center of the design eye point). Additional horizontal field-of-view capability may be added at the sponsor's discretion provided the minimum field-of-view is retained. Vertical field-of-view must not be less than a total of 56° measured from the pilot's and co-pilot's eye point.			X	The horizontal field-of-view is traditionally described as a 180° field-of-view. However, the field-of-view is technically no less than 176°. Field-of-view may be measured using a visual test pattern filling the entire visual scene (all channels) with a matrix of black and white 5° squares.
4.c	Surface contrast ratio.	Not less than 5:1.	N/A	The ratio is calculated by dividing the brightness level of the center, bright square (providing at least 2 foot-lamberts or 7 cd/m ²) by the brightness level of any adjacent dark square.			X	Measurements may be made using a 1° spot photometer and a raster drawn test pattern filling the entire visual scene (all channels) with a test pattern of black and white squares, 5 per square, with a white square in the center of each channel. During contrast ratio testing, simulator aft-cab

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
								and flight deck ambient light levels should be zero.
4.d	Highlight brightness.	Not less than six (6) foot-lamberts (20 cd/m2).	N/A	Measure the brightness of the center, white square while superimposing a highlight on that white square. The use of calligraphic capabilities to enhance the raster brightness is acceptable; however, measuring light points is not acceptable.			X	Measurements may be made using a 1° spot photometer and a raster drawn test pattern filling the entire visual scene (all channels) with a test pattern of black and white squares, 5 per square, with a white square in the center of each channel.
4.e	Surface resolution.	Not greater than two (2) arc minutes.	N/A	An SOC is required and must include the appropriate calculations and an explanation of those calculations. Level B requires surface resolution not greater than three (3) arc minutes.		X	X	When the eye is positioned on a 3° glide slope at the slant range distances indicated with white runway markings on a black runway surface, the eye will subtend two (2) arc minutes:

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
								(1) A slant range of 6,876 ft with stripes 150 ft long and 16 ft wide, spaced 4 ft apart. (2) For Configuration A; a slant range of 5,157 feet with stripes 150 ft long and 12 ft wide, spaced 3 ft apart. (3) For Configuration B; a slant range of 9,884 feet, with stripes 150 ft long and 5.75 ft wide, spaced 5.75 ft apart.
4.f	Light point size.	Not greater than five (5) arc-minutes.	N/A	An SOC is required and must include the relevant calculations and an explanation of those calculations.		X	X	Light point size may be measured using a test pattern consisting of a centrally located single row of light points reduced in length until modulation is just discernible in each visual channel. A row of 48 lights will form a 4° angle or less.
4.g	Light point contrast ratio. A 1° spot photometer may be used to measure a square of at least 1° filled with light points (where light point modulation is just discernible) and compare the results to the measured adjacent background. During contrast ratio testing, simulator aft-cab and flight deck ambient light levels should be zero.							

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
4.g.1	Light point contrast ratio.	Not less than 10:1.	N/A	An SOC is required and must include the relevant calculations.	X			
4.g.2	Light point contrast ratio.	Not less than 25:1.	N/A	An SOC is required and must include the relevant calculations.		X	X	
4.h.	Visual ground segment	The visible segment in the simulator must be $\pm 20\%$ of the segment computed to be visible from the rotorcraft flight deck. This tolerance may be applied at the far end of the displayed segment. However, lights and ground objects computed to be visible from the rotorcraft flight deck at the near end of the visible segment must be visible in the simulator.	Landing configuration, with the aircraft trimmed for the appropriate airspeed, where the MLG are at 100 ft (30m) above the plane of the touchdown zone, on the electronic glide slope with an RVR value set at 1,200 ft (350m).	The QTG must contain appropriate calculations and a drawing showing the data used to establish the rotorcraft location and the segment of the ground that is visible considering design eye point, the rotorcraft attitude, flight deck cut-off angle, and a visibility of 1200 ft (350 m) RVR. Simulator performance must be measured against the QTG calculations. The data submitted must include at least the following: (1) Static rotorcraft dimensions as follows: - Horizontal and vertical distance from main landing gear (MLG) to glideslope reception antenna. - Horizontal and vertical distance from MLG to pilot's eye point. - Static flight deck cut-off angle. (2) Approach data as follows: - Identification of runway. - Horizontal distance from runway threshold to glideslope intercept with runway. - Glideslope angle.	X	X	X	Pre-position for this test is encouraged, and may be achieved via manual or autopilot control to the desired position.

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests								
QPS REQUIREMENTS							INFORMATION	
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
				(iv) Rotorcraft pitch angle on approach. (3) Rotorcraft data for manual testing: - Gross weight. - Rotorcraft configuration. - Approach airspeed. If non-homogenous fog is used to obscure visibility, the vertical variation in horizontal visibility must be described and be included in the slant range visibility calculation used in the computations.				
5. SOUND SYSTEM The sponsor will not be required to repeat the rotorcraft tests (i.e., tests 5.a.1. through 5.a.8. (or 5.b.1. through 5.b.9.) and 5.c., as appropriate) during continuing qualification evaluations if frequency response and background noise test results are within tolerance when compared to the initial qualification evaluation results, and the sponsor shows that no software changes have occurred that will affect the rotorcraft test results. If the frequency response test method is chosen and fails, the sponsor may elect to fix the frequency response problem and repeat the test or the sponsor may elect to repeat the rotorcraft tests. If the rotorcraft tests are repeated during continuing qualification evaluations, the results may be compared against initial qualification evaluation results or rotorcraft master data. All tests in this section must be presented using an unweighted 1/3-octave band format from band 17 to 42 (50 Hz to 16 kHz). A minimum 20 second average must be taken at the location corresponding to the rotorcraft data set. The rotorcraft and flight simulator results must be produced using comparable data analysis techniques.								
5.a.	Basic requirements							
5.a.1	Ready for engine start.	± 5 dB per 1/3 octave band.	Ground.	Normal condition prior to engine start. The APU must be on if appropriate.			X	
5.a.2	All engines at idle; rotor not turning (if applicable)	± 5 dB per 1/3 octave band.	Ground.	Normal condition prior to lift-off.			X	

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
	and rotor turning.							
5.a.3	Hover.	± 5 dB per 1/3 octave band.	Hover.				X	
5.a.4	Climb.	± 5 dB per 1/3 octave band.	En-route climb.	Medium altitude.			X	
5.a.5	Cruise.	± 5 dB per 1/3 octave band.	Cruise.	Normal cruise configuration.			X	
5.a.6	Final approach.	± 5 dB per 1/3 octave band.	Landing.	Constant airspeed, gear down.			X	
5.b.	Special cases.	±5 dB per 1/3 octave band.	As appropriate.				X	These special cases are identified as particularly significant during critical phases of flight and ground operations for a specific rotorcraft type or model.
5.c.	Background noise	±3 dB per 1/3 octave band.	As appropriate.	Results of the background noise at initial qualification must be included in the MQTG. Measurements must be made with the simulation running, the sound muted, and a "dead" flight deck.			X	The simulated sound will be evaluated to ensure that the background noise does not interfere with training, testing, or checking.

Table B2A – Rotorcraft - Full Flight Simulator (FFS) Objective Tests

QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level			Notes
Entry #	Title				B	C	D	
5.d	Frequency response	±5 dB on three (3) consecutive bands when compared to initial evaluation; and ±2 dB when comparing the average of the absolute differences between initial and continuing qualification evaluation.		Applicable only to Continuing Qualification Evaluations. If frequency response plots are provided for each channel at the initial evaluation, these plots may be repeated at the continuing qualification evaluation with the following tolerances applied: (a) The continuing qualification 1/3 octave band amplitudes must not exceed ± 5 dB for three consecutive bands when compared to initial results. (b) The average of the sum of the absolute differences between initial and continuing qualification results must not exceed 2 dB (refer to table C2C in Appendix C).			X	Measurements are compared to those taken during initial qualification evaluation.

Table B2B - Alternative Data Sources, Procedures, and Instrumentation – Level B FSTDs only

Table B2B – Rotorcraft Alternative Data Sources, Procedures, and Instrumentation (Level B FSTDs)		
Test #	Objective Tests Title	Alternative Data Sources, Procedures, and Instrumentation
<i>Note: The standards in this table are required if the data gathering methods described in Section 4.2 are not used.</i>		
PERFORMANCE - START		
1.a.1.a	Engine Start and Accelerations	Data may be acquired using a synchronized video recording of all engine instruments, start buttons, means for fuel introduction and means for moving from “idle” to “flight.” A stopwatch is necessary.
1.a.1.b	Steady State Idle and Operating RPM Conditions	Data may be acquired using a synchronized video recording of all engine instruments, and include the status of the means for moving from “idle” to “flight.”
1.a.2	Power Turbine Speed Trim	Data may be acquired using a synchronized video recording of all engine instruments. Speed trim actuator position may be hand recorded.
1.a.3	Engine and Rotor Speed Governing	Data may be acquired by using a synchronized video of the calibrated helicopter instruments and the force/position measurements of flight deck controls.
PERFORMANCE – SURFACE TAXI		
1.b.1	Minimum Radius turn	TIR, AFM, or Design data may be use
1.b.2	Rate of Turn vs. Nosewheel Steering Angle	Data may be acquired by using a constant tiller position (measured with a protractor), or full pedal application for steady state turn, and synchronized video of heading indicator. If less than full pedal is used, pedal position must be recorded. <i>Note: A single procedure may not be adequate for all rotorcraft steering systems. Appropriate measurement procedures must be devised and proposed for MSP concurrence</i>
1.b.4	Braking	Data may be acquired using a stopwatch and a means for measuring distance such as runway distance markers conforming to runway distance marker standards.
PERFORMANCE – TAKEOFF		
1.c.1	Running Takeoff	Preliminary certification data may be used. Data may be acquired by using a synchronized video of the calibrated helicopter instruments and the force/position measurements of flight deck controls. Collective, cyclic, and pedal position time history must be recorded from the start of collective movement through to normal climb. Indicated torque settings may be hand recorded at the moment of lift-off and in a steady normal climb.

Table B2B – Rotorcraft Alternative Data Sources, Procedures, and Instrumentation (Level B FSTDs)

Test #	Objective Tests Title	Alternative Data Sources, Procedures, and Instrumentation
1.c.2	One Engine Inoperative (OEI), continued takeoff	Data may be acquired by using a synchronized video of the calibrated helicopter instruments and the force/position measurements of flight deck controls. Collective, cyclic, and pedal position time history must be recorded from the start of collective movement through to normal OEI climb. Indicated torque settings may be hand recorded at the moment of lift-off and in a steady normal OEI climb.
PERFORMANCE – CLIMB / LEVEL FLIGHT / DESCENT		
1.f	Level Flight. Trimmed Flight Control Positions.	Data may be acquired by using a synchronized video of the calibrated helicopter instruments and the force/position measurements of flight deck controls.
1.g	Normal Climb. Trimmed Flight Control Positions	
1.h.1	Descent and Trimmed Flight Control Positions.	
1.h.2	Autorotation and Trimmed Flight Control Positions.	
PERFORMANCE – LANDING		
1.j.3	Balked Landing	Data may be acquired by using a synchronized video of the calibrated helicopter instruments and the force/position measurements of flight deck controls. The synchronized video must record the time of the “balk landing” decision.
HANDLING QUALITIES - STATIC CONTROL CHECKS		
2.a.1	Cyclic Control Position vs. Force.	Control positions can be obtained using continuous control position recordings. Force data may be acquired by using a hand held force gauge so that the forces can be cross-plotted against control position in each of the control axes.
2.a.2	Collective/Pedals vs. Force	
2.a.3	Brake Pedal Force vs. Position	Brake pedal positions can be obtained using continuous position recordings. Force data may be acquired by using a hand held force gauge so that the forces can be cross-plotted against brake pedal position.
2.a.4	Trim System Rate (as applicable)	Control positions can be obtained using continuous control position recordings plotted against time to provide rate in each applicable system.
2.a.6	Handling Qualities.	Data may be acquired by direct measurement.
CONTROL SYSTEM FREEPLAY - HANDLING QUALITIES		

Table B2B – Rotorcraft Alternative Data Sources, Procedures, and Instrumentation (Level B FSTDs)

Test #	Objective Tests Title	Alternative Data Sources, Procedures, and Instrumentation
2.c.1	Longitudinal Handling Control Response.	Data may be acquired by using an inertial measurement system, a synchronized video of the calibrated helicopter instruments and the force/position measurements of flight deck controls.
2.c.2	Longitudinal Handling Static Stability	
2.c.3.a	Longitudinal Handling Dynamic Stability, Long Term Response	
2.c.3.b	Longitudinal Handling Dynamic Stability, Short Term Response	
2.c.4	Longitudinal Handling Maneuvering stability	
2.d.1.a	Lateral Handling Control Response	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated helicopter instruments and force/position measurements of flight deck directional controls.
2.d.1.b	Directional Handling Control response.	
2.d.2	Directional Handling Directional Static Stability	
2.d.3.a	Dynamic Lateral and Directional Stability Lateral-Directional Oscillations.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated helicopter instruments, the force/position measurements of flight deck controls, and a stop watch.

Table B2B – Rotorcraft Alternative Data Sources, Procedures, and Instrumentation (Level B FSTDs)

Test #	Objective Tests Title	Alternative Data Sources, Procedures, and Instrumentation
2.d.3.b	Dynamic Lateral and Directional Stability Spiral Stability.	
2.d.3.c	Dynamic Lateral and Directional Stability. Adverse/Proverse Yaw	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated helicopter instruments, the force/position measurements of flight deck controls.

Appendix B3 – Rotorcraft FFS - Simulator Subjective Evaluation

Table B3A – Rotorcraft - Functions and Subjective Tests – Operations Tasks

Table B3A – Rotorcraft - Functions and Subjective Tests – Operations Tasks				
Entry No.	Operations Tasks	Simulator Level		
		B	C	D
Tasks in this table are subject to evaluation if appropriate for the airplane simulated as indicated in the SOQ Configuration List or the level of simulator qualification involved. Items not installed or not functional on the simulator and, therefore, not appearing on the SOQ Configuration List, are not required to be listed as exceptions on the SOQ.				
1. PREPARATION FOR FLIGHT				
1.a	Flight deck check: switches, indicators, systems, and equipment.	X	X	X
2. APU/Engine start and run-up.				
2.a	Normal start procedures.	X	X	X
2.b	Alternate start procedures.	X	X	X
2.c	Abnormal starts and shutdowns (e.g., hot start, hung start)	X	X	X
2.d	Rotor engagement.	X	X	X
2.e	System checks.	X	X	X
3. Taxiing – Ground				
3.a	Power required to taxi.	X	X	X
3.b	Brake effectiveness.	X	X	X
3.c	Ground handling.	X	X	X
3.d	Water handling (if applicable).		X	X
3.e	Abnormal/emergency procedures:			
3.e.1	Brake system failure.	X	X	X
3.e.2	Ground resonance.		X	X
3.e.3	Dynamic rollover.		X	X
3.e.4	Deployment of emergency floats / water landing.		X	X
3.e.5	Others listed on the SOQ. Note: For Level B - the system, task, or procedure may be examined if the appropriate aircraft system or control is simulated in the FFS and is working properly.		X	X
4. Taxiing – Hover				
4.a	Takeoff to a hover.	X	X	X
4.b	Instrument response.			
4.b.1	Engine instruments.	X	X	X
4.b.2	Flight instruments.	X	X	X
4.b.3	Hovering turns.	X	X	X
4.c	Hover power checks.			
4.c.1	In ground effect (IGE).	X	X	X
4.c.2	Out of ground effect (OGE).	X	X	X
4.d	Crosswind/tailwind hover.	X	X	X
4.e	Translating tendency.	X	X	X
4.f	External load operations.			
4.f.1	Hookup.		X	X
4.f.2	Release.		X	X
4.f.3	Winch operations.		X	X
4.g	Abnormal/emergency procedures:			
4.g.1	Engine failure.	X	X	X
4.g.2	Fuel governing system failure.	X	X	X
4.g.3.1	Settling with power (OGE).	X	X	X
4.g.3.2	Vortex ring state	X	X	X
4.g.5	Stability augmentation system failure.	X	X	X
4.g.6	Directional control malfunction.	X	X	X
4.g.7	Loss of tail rotor effectiveness (LTE).		X	X
4.g.8	Others listed on the SOQ. Note: For Level B - the system, task, or procedure may be examined if the appropriate aircraft system or control is simulated in the FFS and is working properly.		X	X
4.h	Pre-takeoff checks.	X	X	X
5. Takeoff / Translational Flight.				
5.a	Forward (up to effective translational lift).		X	X

Table B3A – Rotorcraft - Functions and Subjective Tests – Operations Tasks				
Entry No.	Operations Tasks	Simulator Level		
		B	C	D
5.b	Sideward (up to limiting airspeed).		X	X
5.c	Rearward (up to limiting airspeed).		X	X
6. Takeoff and Departure Phase.				
6.a	Normal.			
6.a.1	From ground.	X	X	X
6.a.2	From hover.	X	X	X
6.a.2.a	• Cat A.	X	X	X
6.a.2.b	• Cat B.	X	X	X
6.a.3	Running.	X	X	X
6.a.4	Crosswind/tailwind.	X	X	X
6.a.5	Maximum performance.	X	X	X
6.a.6	Instrument.	X	X	X
6.a.7	Takeoff from a confined area.	X	X	X
6.a.8	Takeoff from a pinnacle / platform.	X	X	X
6.a.9	Takeoff from a slope.	X	X	X
6.a.10	External load operations.		X	X
6.b	Abnormal/emergency procedures:			
6.b.1	Takeoff with engine failure after critical decision point (CDP).	X	X	X
6.b.1.a	• Cat A.		X	X
6.b.1.b	• Cat B.		X	X
6.c	Rejected takeoff.			
6.c.1	Land	X	X	X
6.c.2	Water (if appropriate)	X	X	X
6.d	Instrument departure	X	X	X
6.e	Others listed on the SOQ. <i>Note: For Level B - the system, task, or procedure may be examined if the appropriate aircraft system or control is simulated in the FFS and is working properly.</i>		X	X
7. Climb.				
7.a	Normal.	X	X	X
7.b	Obstacle clearance.	X	X	X
7.c	Vertical.		X	X
7.d	One engine inoperative.	X	X	X
7.e	Others listed on the SOQ. <i>Note: For Level B - the system, task, or procedure may be examined if the appropriate aircraft system or control is simulated in the FFS and is working properly.</i>		X	X
8. Cruise				
8.a	Performance.	X	X	X
8.b	Flying qualities.	X	X	X
8.c	Turns.	X	X	X
8.c.1	• Timed.	X	X	X
8.c.2	• Normal.	X	X	X
8.c.3	• Steep.	X	X	X
8.d	Accelerations and decelerations.	X	X	X
8.e	High speed vibrations.	X	X	X
8.f	External Load Operations (see entry 4.f. of this table)		X	X
8.g	Abnormal/emergency procedures			
8.g.1	Engine fire.	X	X	X
8.g.2	Engine failure.	X	X	X
8.g.3	Inflight engine shutdown and restart.	X	X	X
8.g.4	Fuel governing system failures.	X	X	X
8.g.5	Directional control malfunction.	X	X	X
8.g.6	Hydraulic failure.	X	X	X
8.g.7	Stability system failure.	X	X	X
8.g.8	Rotor vibrations.	X	X	X
8.g.9	Recovery from unusual attitudes	X	X	X
9. Descent.				

Table B3A – Rotorcraft - Functions and Subjective Tests – Operations Tasks					
Entry No.	Operations Tasks	Simulator Level			
		B	C	D	
9.a	Normal.	X	X	X	
9.b	Maximum rate.	X	X	X	
9.c	Autorotative:				
9.c.1	• Straight-in.	X	X	X	
9.c.2	• With turn.	X	X	X	
9.d	External Load		X	X	
10. Approach.					
10.a	Non-precision.	X	X	X	
10.a.1	All engines operating.	X	X	X	
10.a.2	One or more engines inoperative.	X	X	X	
10.a.3	Approach procedures:	X	X	X	
10.a.3.a	• NDB	X	X	X	
10.a.3.b	• VOR, RNAV, TACAN	X	X	X	
10.a.3.c	• ASR	X	X	X	
10.a.3.d	• Circling	X	X	X	
10.a.3.e	• Helicopter only.	X	X	X	
10.a.4	Missed approach.	X	X	X	
10.a.4.a	All engines operating.	X	X	X	
10.a.4.b	One or more engines inoperative.	X	X	X	
10.b	Precision.	X	X	X	
10.b.1	All engines operating.	X	X	X	
10.b.2	Manually controlled - one or more engines inoperative.	X	X	X	
10.b.3	Approach procedures:	X	X	X	
10.b.3.a	• PAR	X	X	X	
10.b.3.b	• MLS	X	X	X	
10.b.3.c	• ILS	X	X	X	
10.b.3.c	(1) Manual (raw data).	X	X	X	
10.b.3.c	(2) Flight director only.	X	X	X	
10.b.3.c	(3) Autopilot*only.	X	X	X	
10.b.3.c	(4) Cat I.	X	X	X	
10.b.3.c	(5) Cat II.	X	X	X	
10.b.4	Missed approach.				
10.b.4.a	All engines operating.	X	X	X	
10.b.4.b	One or more engines inoperative.	X	X	X	
10.b.4.c	Stability system failure.	X	X	X	
10.c	Others listed on the SOQ. <i>Note: For Level B - the system, task, or procedure may be examined if the appropriate aircraft system or control is simulated in the FFS and is working properly.</i>		X	X	
11. Landings and Approaches to Landings.					
11.a	Visual Approaches				
11.a.1	Normal.	X	X	X	
11.a.2	Steep.	X	X	X	
11.a.3	Shallow.	X	X	X	
11.a.4	Crosswind.	X	X	X	
11.a.5	Category A profile.		X	X	
11.a.6	Category B profile.		X	X	
11.a.7	External Load.		X	X	
11.b	Abnormal/emergency procedures:				
11.b.1	Directional control failure.	X	X	X	
11.b.2	Hydraulics failure.	X	X	X	
11.b.3	Fuel governing failure.	X	X	X	
11.b.4	Autorotation.	X	X	X	
11.b.5	Stability system failure.	X	X	X	
11.b.6	Others listed on the SOQ. <i>Note: For Level B - the system, task, or procedure may be examined if the appropriate aircraft system or control is simulated in the FFS and is working properly.</i>		X	X	

Table B3A – Rotorcraft - Functions and Subjective Tests – Operations Tasks				
Entry No.	Operations Tasks	Simulator Level		
		B	C	D
11c	Landings.			
11.c.1	Normal.	X	X	X
11.c.1.a	• Running.	X	X	X
11.c.1.b	• From Hover.	X	X	X
11.c.2	Pinnacle/platform.	X	X	X
11.c.3	Confined area	X	X	X
11.c.4	Slope.		X	X
11.c.5	Crosswind.	X	X	X
11.c.6	Tailwind.	X	X	X
11.c.7	Rejected Landing.	X	X	X
11.c.8	Abnormal/emergency procedures:			
11.c.8.a	From autorotation.		X	X
11.c.8.b	One or more engines inoperative.	X	X	X
11.c.8.c	Directional control failure.	X	X	X
11.c.8.d	Hydraulics failure.	X	X	X
11.c.8.e	Stability augmentation system failure.	X	X	X
11.c.9	Others listed on the SOQ. Note: For Level B - the system, task, or procedure may be examined if the appropriate aircraft system or control is simulated in the FFS and is working properly.		X	X
12.	Any Flight Phase.			
12.a.1	Air conditioning.	X	X	X
12.a.2	Anti-icing/deicing.	X	X	X
12.a.3	Auxiliary power-plant.	X	X	X
12.a.4	Communications.	X	X	X
12.a.5	Electrical.	X	X	X
12.a.6	Fire detection and suppression.	X	X	X
12.a.7	Stabilizer.	X	X	X
12.a.8	Flight controls.	X	X	X
12.a.9	Fuel and oil.	X	X	X
12.a.10	Hydraulic.	X	X	X
12.a.11	Landing gear.	X	X	X
12.a.12	Oxygen.	X	X	X
12.a.13	Pneumatic.	X	X	X
12.a.14	Powerplant.	X	X	X
12.a.15	Flight control computers.	X	X	X
12.a.16	Stability and control augmentation.	X	X	X
12.b	Flight management and guidance system.			
12.b.1	Airborne radar.	X	X	X
12.b.2	Automatic landing aids.	X	X	X
12.b.3	Autopilot.	X	X	X
12.b.4	Collision avoidance system.	X	X	X
12.b.5	Flight data displays.	X	X	X
12.b.6	Flight management computers.	X	X	X
12.b.7	Heads-up displays.	X	X	X
12.b.8	Navigation systems.	X	X	X
12.c	Airborne procedures.			
12.c.1	Holding.	X	X	X
12.c.2	Air hazard avoidance.	X	X	X
12.c.3	Retreating blade stall recovery.	X	X	X
12.c.4	Mast bumping.	X	X	X
12.c.5	Loss of directional control.	X	X	X
12.c.6	Loss of tail rotor effectiveness.		X	X
12.c.7	Others listed on the SOQ. Note: For Level B - the system, task, or procedure may be examined if the appropriate aircraft system or control is simulated in the FFS and is working properly.		X	X
13.	Engine Shutdown and Parking.			

Table B3A – Rotorcraft - Functions and Subjective Tests – Operations Tasks				
Entry No.	Operations Tasks	Simulator Level		
		B	C	D
13.a	Engine and systems operation.	X	X	X
13.b	Parking brake operation.	X	X	X
13.c	Rotor brake operation.	X	X	X
13.d	Abnormal/emergency procedures.	X	X	X

* "Autopilot" means attitude retention mode of operation.

Table B3B – Rotorcraft Class I Airport Models or Landing Area Models - Functions and Subjective Tests

Table B3B – Rotorcraft Class I Airport and Landing Area Models - Functions and Subjective Tests				
Entry No.	Rotorcraft Class I Visual Scene Models	Simulator Level		
		B	C	D
<i>This table specifies the minimum airport visual model content and functionality to qualify a simulator at the indicated level. This table applies only to the airport scenes and landing areas required for simulator qualification; i.e., two rotorcraft landing area models for Level B simulators; four rotorcraft landing area models for Level C and Level D simulators.</i> Note: There are no Level A rotorcraft simulators.				
1. FUNCTIONAL TEST CONTENT REQUIREMENTS FOR LEVEL-B ROTORCRAFT SIMULATORS.				
The following is the minimum airport model content requirement to satisfy visual capability tests, and provides suitable visual cues to allow completion of all functions and subjective tests described in this Appendix for simulators at Levels A and B.				
1.a.	A minimum of one (1) representative airport and one (1) representative rotorcraft landing area model. The airport and the rotorcraft landing area may be contained within the same model. If but if this option is selected, the approach path to the airport runway(s) and the approach path to the rotorcraft landing area must be different. The model(s) used to meet the following requirements may be demonstrated at either a fictional or a real-world airport or rotorcraft landing area, but each must be acceptable to the sponsor's TPAA, selectable from the IOS, and listed on the SOQ.	X		
1.b.	The fidelity of the visual scene must be sufficient for the aircrew to visually identify the airport and/or rotorcraft landing area; determine the position of the simulated rotorcraft within the visual scene; successfully accomplish take-offs, approaches, and landings; and maneuver around the airport on the ground, or hover taxi, as necessary.	X		
1.c.	Runways			
1.c.1	Visible runway number.	X		
1.c.2	Runway threshold elevations and locations must be modeled to provide sufficient correlation with airplane systems (e.g., altimeter).	X		
1.c.3	Runway surface and markings.	X		
1.c.4	Lighting for the runway in use including runway edge and centerline.	X		
1.c.5	Lighting, visual approach aid and approach lighting of appropriate colors.	X		
1.c.6	Representative taxiway lights.	X		
1.d.	Other rotorcraft landing area:			
1.d.1	Standard heliport designation ("H") marking, properly sized and oriented.	X		
1.d.2	Perimeter markings for the Touchdown and Lift-Off Area (TLOF) or the Final Approach and Takeoff Area (FATO), as appropriate.	X		
1.d.3	Perimeter lighting for the TLOF or the FATO areas, as appropriate.	X		
1.d.4	Appropriate markings and lighting to allow movement from the runway or rotorcraft landing area to another part of the landing facility.	X		
2. FUNCTIONAL TEST CONTENT REQUIREMENTS FOR LEVEL C AND LEVEL D SIMULATORS.				
The following is the minimum airport/landing area model content requirement to satisfy visual capability tests, and provide suitable visual cues to allow completion of all functions and subjective tests described in this attachment for simulators at Level C and Level D. Not all of the elements described in this section must be found in a single airport/landing area scene. However, all of the elements described in this section must be found throughout a combination of the four (4) airport/landing area models described in entry 2.a. The representations of the hazards (as described in 2.d.) must be "hard objects" that interact as such if contacted by the simulated rotorcraft. Additionally, surfaces on which the rotorcraft lands must be "hard surfaces." The model(s) used to meet the following requirements must be demonstrated at either a fictional or a real-world airport or rotorcraft landing area, and each must be acceptable to the sponsor's TPAA, selectable from the IOS, and listed on the SOQ.				
2.a.	Airport/Rotorcraft Landing Areas Scenes. – The visual database must present least the following:			
2.a.1	At least one (1) representative airport.		X	X
2.a.2	At least three representative non-airport landing areas, as follows:		X	X
2.a.2.a	At least one (1) representative rotorcraft landing area situated on a substantially elevated surface with respect to the surrounding structures or terrain (e.g., building top, offshore oil rig).		X	X

Table B3B – Rotorcraft Class I Airport and Landing Area Models - Functions and Subjective Tests				
Entry No.	Rotorcraft Class I Visual Scene Models	Simulator Level		
		B	C	D
2.a.2.b	At least one (1) rotorcraft landing area that meets the definition of a “confined landing area.”		X	X
2.a.2.c	At least one (1) rotorcraft landing area on a sloped surface where the slope is at least 2½°.		X	X
2.b	For each of the airport/rotorcraft landing areas described in 2.a., the simulator must be able to provide at least the following:			
2.b.1	A night and twilight (dusk) environment.		X	X
2.b.2	A daylight environment.			X
2.c.	Non-airport rotorcraft landing areas must have the following:			
2.c.1	Representative buildings, structures, and lighting within appropriate distances.		X	X
2.c.2	Representative moving and static clutter (e.g., other aircraft, power carts, tugs, fuel trucks).		X	X
2.c.3	Representative depiction of terrain and obstacles as well as significant and identifiable natural and cultural features, within 25 NM of the reference landing area.		X	X
2.c.4	Standard heliport designation (“H”) marking, properly sized and oriented.		X	X
2.c.5	Perimeter markings for the Touchdown and Lift-Off Area (TLOF) or the Final Approach and Takeoff Area (FATO), as appropriate.		X	X
2.c.6	Perimeter lighting for the TLOF or the FATO areas, as appropriate.		X	X
2.c.7	Appropriate markings and lighting to allow movement from the area to another part of the landing facility, if appropriate.		X	X
2.c.8	Representative markings, lighting, and signage, including a windsock that gives appropriate wind cues.		X	X
2.c.9	Appropriate markings, lighting, and signage necessary for position identification, and to allow movement from the landing area to another part of the landing facility.		X	X
2.c.10	Representative moving and static ground traffic (e.g., vehicular and aircraft), including the ability to present surface hazards (e.g., conflicting traffic, vehicular or aircraft, on or approaching the landing area).		X	X
2.c.11	Portrayal of landing surface contaminants, including lighting reflections when wet and partially obscured lights when snow is present, or suitable alternative effects.		X	X
2.d.	All of the following three (3) hazards must be presented in a combination of the three (3) non-airport landing areas (described in entry 2.a.2 of this table) and each of these non-airport landing areas must have at least one of the following hazards:			
2.d.1	Other airborne traffic.		X	X
2.d.2	Buildings, trees, or other vertical obstructions in the immediate landing area.		X	X
2.d.3	Suspended wires in the immediate landing area.		X	X
2.e.	Airport applications. Each airport must have the following:			
2.e.1	At least one runway designated as “in-use,” appropriately marked and capable of being lighted fully.		X	X
2.e.2	Runway threshold elevations and locations must be modeled to provide sufficient correlation with rotorcraft systems (e.g., HGS, GPS, altimeter). Slopes in runways, taxiways, and ramp areas, if depicted in the visual scene, may not cause distracting or unrealistic effects, including pilot eye-point height variation.	X	X	X
2.e.3	Appropriate approach lighting systems and airfield lighting for a VFR circuit and landing, non-precision approaches and landings, and precision approaches and landings, as appropriate.		X	X
2.e.4	Representative taxiway lights.			X
3.	Airport or landing area model management. The following is the minimum visual scene management requirements.			
3.a.	Runway and rotorcraft landing area approach lighting must fade into view in accordance with the environmental conditions set in the simulator.	X	X	X
3.b.	The direction of strobe lights, approach lights, runway edge lights, visual landing aids, runway centerline lights, threshold lights, touchdown zone lights, and TLOF or FATO lights must be replicated.	X	X	X
4.	Visual feature recognition. The following are the minimum distances at which runway features must be visible. Distances are measured from runway threshold or a rotorcraft landing area to a rotorcraft aligned with the runway or rotorcraft landing area on an extended 3° glide-slope in simulated meteorological conditions. For circling approaches, all tests apply to the runway used for the initial approach and to the runway of intended landing.			
4.a.	For runways: runway definition, strobe lights, approach lights, and runway edge lights from 5 sm (8 km) of the runway threshold.	X	X	X

Table B3B – Rotorcraft Class I Airport and Landing Area Models - Functions and Subjective Tests

Entry No.	Rotorcraft Class I Visual Scene Models	Simulator Level		
		B	C	D
4.b.	For runways: centerline lights and taxiway definition from 3 sm (5 km).	X	X	X
4.c.	For runways: Visual Approach Aid lights (VASI or PAPI) from 3 sm (5 km) of the threshold.	X		
4.d.	For runways: Visual Approach Aid lights (VASI or PAPI) from 5 sm (8 km) of the threshold.		X	X
4.e.	For runways: runway threshold lights and touchdown zone lights from 2 sm (3 km).	X	X	X
4.f.	For runways and rotorcraft landing areas: markings within range of landing lights for night/twilight scenes and the surface resolution test on daylight scenes, as required.	X	X	X
4.g.	For circling approaches, the runway of intended landing and associated lighting must fade into view in a non-distracting manner.	X	X	X
4.h.	For rotorcraft landing areas: landing direction lights and raised FATO lights from 1 sm (1.5 km).	X	X	X
4.i.	For rotorcraft landing areas: Flush mounted FATO lights, TOFL lights, and the lighted windsock from 0.5 sm (750 m).			X
4.j.	Hover taxiway lighting (yellow/blue/yellow cylinders) from TOFL area.			X
5. AIRPORT OR ROTORCRAFT LANDING AREA MODEL CONTENT.				
The following prescribes the minimum requirements for an airport/rotorcraft landing area model and identifies other aspects of the environment that must correspond with that model for simulators at Level B, Level C, and Level D. For circling approaches, all tests apply to the runway used for the initial approach and to the runway of intended landing. If all runways or landing areas in a visual model used to meet the requirements of this attachment are not designated as “in use,” then the “in use” runways/landing areas must be listed on the SOQ (e.g., KORD, Rwy 9R, 14L, 22R). Models of airports or rotorcraft landing areas with more than one runway or landing area must have all significant runways or landing areas not “in-use” visually depicted for airport runway/landing area recognition purposes. The use of white or off-white light strings that identify the runway or landing area for twilight and night scenes are acceptable for this requirement; and rectangular surface depictions are acceptable for daylight scenes. A visual system’s capabilities must be balanced between providing visual models with an accurate representation of the airport and a realistic representation of the surrounding environment. Each runway or rotorcraft landing area designated as an “in-use” runway or area must include the following detail that is developed using airport pictures, construction drawings and maps, or other similar data, or developed in accordance with published regulatory material; however, this does not require that such models contain details that are beyond the design capability of the currently qualified visual system. Only one “primary” taxi route from parking to the runway end or rotorcraft takeoff/landing area will be required for each “in-use” runway or rotorcraft takeoff/landing area.				
5.a.	The surface and markings for each “in-use” runway or rotorcraft landing area must include the following:			
5.a.1	For airports: runway threshold markings, runway numbers, touchdown zone markings, fixed distance markings, runway edge markings, and runway centerline stripes.	X	X	X
5.a.2	For rotorcraft landing areas: markings for standard heliport identification (“H”) and TOFL, FATO, and safety areas.	X	X	X
5.b.	The lighting for each “in-use” runway or rotorcraft landing area must include the following:			
5.b.1	For airports: runway approach, threshold, edge, end, centerline (if applicable), touchdown zone (if applicable), leadoff, and visual landing aid lights or light systems for that runway.	X	X	X
5.b.2	For rotorcraft landing areas: landing direction, raised and flush FATO, TOFL, windsock lighting.	X	X	X
5.c.	The taxiway surface and markings associated with each “in-use” runway or rotorcraft landing area must include the following:			
5.c.1	For airports: taxiway edge, centerline (if appropriate), runway hold lines, and ILS critical area(s).	X	X	X
5.c.2	For rotorcraft landing areas: taxiways, taxi routes, and aprons.	X	X	X
5.d.	The taxiway lighting associated with each “in-use” runway or rotorcraft landing area must include the following:			
5.d.1	For airports: runway edge, centerline (if appropriate), runway hold lines, ILS critical areas.	X	X	X
5.d.2	For rotorcraft landing areas: taxiways, taxi routes, and aprons.	X	X	X
5.d.3	For airports: taxiway lighting of correct color.			X
5.e.	Airport signage associated with each “in-use” runway or rotorcraft landing area must include the following:			
5.e.1	For airports: signs for runway distance remaining, intersecting runway with taxiway, and intersecting taxiway with taxiway.	X	X	X

Table B3B – Rotorcraft Class I Airport and Landing Area Models - Functions and Subjective Tests					
Entry No.	Rotorcraft Class I Visual Scene Models	Simulator Level			
		B	C	D	
5.e.2	For rotorcraft landing areas: as appropriate for the model used.	X	X	X	
5.f.	Required visual model correlation with other aspects of the airport or rotorcraft landing environment simulation:				
5.f.1	The airport or rotorcraft landing area model must be properly aligned with the navigational aids that are associated with operations at the “in-use” runway or rotorcraft landing area.	X	X	X	
5.f.2	The simulation of runway or rotorcraft landing area contaminants must be correlated with the displayed runway surface and lighting where applicable.		X	X	
6. CORRELATION WITH ROTORCRAFT AND ASSOCIATED EQUIPMENT. The following are the minimum correlation comparisons that must be made:					
6.a.	Visual system compatibility with aerodynamic programming.	X	X	X	
6.b.	Visual cues to assess sink rate and depth perception during landings.	X	X	X	
6.c.	Accurate portrayal of environment relating to flight simulator attitudes.	X	X	X	
6.d.	The visual scene must correlate with integrated rotorcraft systems (e.g., terrain, traffic and weather avoidance systems and Head-up Guidance System (HGS)).		X	X	
6.e.	Representative visual effects for each visible, own-ship, rotorcraft external light(s) – taxi and landing light lobes (including independent operation, if appropriate).	X	X	X	
6.f.	The effect of rain removal devices.		X	X	
7. SCENE QUALITY. The following are the minimum scene quality tests that must be conducted:					
7.a.	Surfaces and textural cues must be free from apparent and distracting quantization (aliasing).		X	X	
7.b.	System capable of portraying full color realistic textural cues.		X	X	
7.c.	The system light points must be free from distracting jitter, smearing or streaking.	X	X	X	
7.d.	Demonstration of occulting through each channel of the system in an operational scene.	X	X	X	
7.e.	Demonstration of a minimum of ten levels of occulting through each channel of the system in an operational scene.		X	X	
7.f.	System capable of providing focus effects that simulate rain.		X	X	
7.g.	System capable of providing focus effects that simulate light point perspective growth.		X	X	
7.h.	Runway light controls capable of six discrete light steps (0-5).	X	X	X	
8. ENVIRONMENTAL EFFECTS. The following are the minimum environmental effects that must be available:					
8.a.	The displayed scene corresponding to the appropriate surface contaminants and include appropriate lighting reflections for wet, partially obscured lights for snow, or alternative effects.				X
8.b.	Special weather representations which include:				
8.b.1	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 2,000 ft (600 m) above the surface and within a radius of 10 sm (16 km) from the airport or rotorcraft landing area.				X
8.b.2	One airport or rotorcraft landing area with a snow scene to include terrain snow and snow-covered surfaces.				X
8.c.	In - cloud effects such as variable cloud density, speed cues and ambient changes.		X	X	
8.d.	The effect of multiple cloud layers representing few, scattered, broken and overcast conditions giving partial or complete obstruction of the ground scene.		X	X	
8.e.	Visibility and RVR measured in terms of distance. Visibility/RVR checked at 2,000 ft (600 m) above the airport or rotorcraft landing area and at two heights below 2,000 ft with at least 500 ft of separation between the measurements. The measurements must be taken within a radius of 10 sm (16 km) from the airport or rotorcraft landing area.	X	X	X	
8.f.	Patchy fog giving the effect of variable RVR.				X
8.g.	Effects of fog on airport lighting such as halos and defocus.		X	X	
8.h.	Effect of own-ship lighting in reduced visibility, such as reflected glare, including landing lights, strobes, and beacons.		X	X	
8.i.	Wind cues to provide the effect of blowing snow or sand across a dry runway or taxiway selectable from the instructor station.				X
8.j.	“White-out” or “Brown-out” effects due to rotor downwash beginning at a distance above the ground equal to the rotor diameter.				X
9. INSTRUCTOR CONTROLS. The following are the minimum instructor controls that must be available as indicated.					
9.a.	Environmental effects, e.g. cloud base, cloud effects, cloud density, visibility in statute miles/ kilometers and RVR in feet/meters.	X	X	X	

Table B3B – Rotorcraft Class I Airport and Landing Area Models - Functions and Subjective Tests				
Entry No.	Rotorcraft Class I Visual Scene Models	Simulator Level		
		B	C	D
9.b.	Airport or rotorcraft landing area selection.	X	X	X
9.c.	Airport or rotorcraft landing area lighting, including variable intensity.	X	X	X
9.d.	Dynamic effects including ground and flight traffic.		X	X
10. An example of being able to “combine two airport models to achieve two “in-use” runways: One runway designated as the “in-use” runway in the first model of the airport, and the second runway designated as the “in-use” runway in the second model of the same airport. For example, the clearance is for the ILS approach to Runway 27, Circle to Land on Runway 18 right. Two airport visual models might be used: the first with Runway 27 designated as the “in use” runway for the approach to runway 27, and the second with Runway 18 Right designated as the “in use” runway. When the pilot breaks off the ILS approach to runway 27, the instructor may change to the second airport visual model in which runway 18 Right is designated as the “in use” runway, and the pilot would make a visual approach and landing. This process is acceptable to the FAA as long as the temporary interruption due to the visual model change is not distracting to the pilot.				
11. Sponsors are not required to provide every detail of a runway, but the detail that is provided should be correct within reasonable limits.				

Table B3C – Rotorcraft Class II Airport or Landing Area Models - Functions and Subjective Tests

Table B3C – Rotorcraft Class II Airport and Landing Area Models - Functions and Subjective Tests						
Entry No.	Rotorcraft Class II Visual Scene Models			Simulator Level		
				B	C	D
<i>This table specifies the minimum airport or rotorcraft landing area visual model content and functionality necessary to add visual models to a simulator's visual model library (i.e., beyond those necessary for qualification at the stated level) without the necessity of further involvement of the NSPM or TPAA.</i> <i>Note: There are no Level A rotorcraft simulators.</i>						
1. AIRPORT OR LANDING AREA MODEL MANAGEMENT.						
The following is the minimum visual scene management requirements for simulators at Levels B, C, and D.						
1.a.	The installation and direction of the following lights must be replicated for the “in-use” surface:					
1.a.1	For “in-use” runways: strobe lights, approach lights, runway edge lights, visual landing aids, runway centerline lights, threshold lights, and touchdown zone lights.			X	X	X
1.a.2	For “in-use” rotorcraft landing areas: ground level TLOF perimeter lights, elevated TLOF perimeter lights (if applicable), Optional TLOF lights (if applicable), ground FATO perimeter lights, elevated TLOF lights (if applicable), and landing direction lights.			X	X	X
2. VISUAL FEATURE RECOGNITION.						
The following are the minimum distances at which runway or landing area features must be visible for simulators at Level B, C, and D. Distances are measured from runway threshold or a rotorcraft landing area to an aircraft aligned with the runway or rotorcraft landing area on a 3° glide-slope from the aircraft to the touchdown point, in simulated meteorological conditions. For circling approaches, all tests apply to the runway used for the initial approach and to the runway of intended landing.						
2.a.	For Runways:					
2.a.1	Strobe lights, approach lights, and edge lights from 5 sm (8 km) of the threshold.			X	X	X
2.a.2	Centerline lights and taxiway definition from 3 sm (5 km).			X	X	X
2.a.3	Visual Approach Aid lights (VASI or PAPI) from 3 sm (5 km) of the threshold.			X		
2.a.4	Visual Approach Aid lights (VASI or PAPI) from 5 sm (8 km) of the threshold.				X	X
2.a.5	Threshold lights and touchdown zone lights from 2 sm (3 km).			X	X	X
2.a.6	Markings within range of landing lights for night/twilight (dusk) scenes and as required by the surface resolution test on daylight scenes.			X	X	X
2.a.7	For circling approaches, the runway of intended landing and associated lighting must fade into view in a non-distracting manner.			X	X	X
2.b.	For Rotorcraft landing areas:					
2.b.1	Landing direction lights and raised FATO lights from 1 sm (1.5 km).			X	X	X
2.b.2	Flush mounted FATO lights, TOFL lights, and the lighted windsock from 0.5 sm (750 m)				X	X
2.b.3	Hover taxiway lighting (yellow/blue/yellow cylinders) from TOFL area.				X	X
2.b.4	Markings within range of landing lights for night/twilight (dusk) scenes and as required by the surface resolution test on daylight scenes.			X	X	X
3. AIRPORT OR ROTORCRAFT LANDING AREA MODEL CONTENT.						
The following prescribes the minimum requirements for what must be provided in an airport visual model and identifies other aspects of the airport environment that must correspond with that model for simulators at Level B, C, and D. The detail must be developed using airport pictures, construction drawings and maps, or other similar data, or developed in accordance with published regulatory material; however, this does not require that airport or rotorcraft landing area models contain details that are beyond the designed capability of the currently qualified visual system. For circling approaches, all requirements of this section apply to the runway used for the initial approach and to the runway of intended landing. Only one “primary” taxi route from parking to the runway end or rotorcraft takeoff/landing area will be required for each “in-use” runway or rotorcraft takeoff/landing area.						
3.a.	The surface and markings for each “in-use” runway or rotorcraft landing area must include the following:					
3.a.1	For airports: runway threshold markings, runway numbers, touchdown zone markings, fixed distance markings, runway edge markings, and runway centerline stripes.			X	X	X
3.a.2	For rotorcraft landing areas: Standard heliport marking (“H”), TOFL, FATO, and safety areas.			X	X	X
3.b.	The lighting for each “in-use” runway or rotorcraft landing area must include the following:					
3.b.1	For airports: runway approach, threshold, edge, end, centerline (if applicable), touchdown zone (if applicable), leadoff, and visual landing aid lights or light systems for that runway.			X	X	X
3.b.2	For rotorcraft landing areas: landing direction, raised and flush FATO, TOFL, windsock lighting.			X	X	X

Table B3C – Rotorcraft Class II Airport and Landing Area Models - Functions and Subjective Tests					
Entry No.	Rotorcraft Class II Visual Scene Models	Simulator Level			
		B	C	D	
3.c.	The taxiway surface and markings associated with each “in-use” runway or rotorcraft landing area must include the following:				
3.c.1	For airports: taxiway edge, centerline (if appropriate), runway hold lines, and ILS critical area(s).	X	X	X	
3.c.2	For rotorcraft landing areas: taxiways, taxi routes, and aprons.	X	X	X	
3.d.	The taxiway lighting associated with each “in-use” runway or rotorcraft landing area must include the following:				
3.d.1	For airports: runway edge, centerline (if appropriate), runway hold lines, ILS critical areas.	X	X	X	
3.d.2	For rotorcraft landing areas: taxiways, taxi routes, and aprons.	X	X	X	
3.d.3	For airports: taxiway lighting of correct color.			X	
4. REQUIRED VISUAL MODEL CORRELATION WITH OTHER ASPECTS OF THE AIRPORT ENVIRONMENT SIMULATION.					
The following are the minimum visual model correlation tests that must be conducted as indicated.					
4.a.	The airport model must be properly aligned with the navigational aids that are associated with operations at the “in-use” runway.	X	X	X	
4.b.	Slopes in runways, taxiways, and ramp areas, if depicted in the visual scene, must not cause distracting or unrealistic effects.	X	X	X	
5. CORRELATION WITH ROTORCRAFT AND ASSOCIATED EQUIPMENT. The following are the minimum correlation comparisons that must be made as indicated.					
5.a.	Visual system compatibility with aerodynamic programming.	X	X	X	
5.b.	Accurate portrayal of environment relating to flight simulator attitudes.	X	X	X	
5.c.	Visual cues to assess sink rate and depth perception during landings.	X	X	X	
6. SCENE QUALITY. The following are the minimum scene quality tests that must be conducted as indicated.					
6.a.	Light points free from distracting jitter, smearing or streaking.	X	X	X	
6.b.	Surfaces and textural cues free from apparent and distracting quantization (aliasing).		X	X	
6.c.	Correct color and realistic textural cues.			X	
7. INSTRUCTOR CONTROLS: The following are the minimum instructor controls that must be available as indicated.					
7.a.	Environmental effects, e.g., cloud base (if used), cloud effects, cloud density, visibility in statute miles/kilometers and RVR in feet/meters.	X	X	X	
7.b.	Airport/Heliport selection.	X	X	X	
7.c.	Airport lighting including variable intensity.	X	X	X	
7.d.	Dynamic effects including ground and flight traffic.		X	X	
8. Sponsors are not required to provide every detail of a runway or rotorcraft landing area, but the detail that is provided must be correct within the capabilities of the system.		X	X	X	

Table B3D – Rotorcraft - Functions and Subjective Tests – Motion System

Table B3D – Rotorcraft - Functions and Subjective Tests – Motion System						
Entry No.	Rotorcraft Motion System (and Special Aerodynamic Model) Effects	Simulator Level			Notes/Information	
		B	C	D		
<i>This table specifies motion effects that are required to indicate when a flight crewmember must be able to recognize an event or situation. Where applicable, flight simulator pitch, side loading and directional control characteristics must be representative of the rotorcraft.</i>						
1.	Runway rumble, oleo deflection, ground speed, uneven runway, runway and taxiway centerline light characteristics: Procedure: After the rotorcraft has been pre-set to the takeoff position and then released, taxi at various speeds with a smooth runway and note the general characteristics of the simulated runway rumble effects of oleo deflections. Repeat the maneuver with a runway roughness of 50%, then with maximum roughness. Note the associated motion vibrations affected by ground speed and runway roughness.	X	X	X	If time permits, different gross weights can also be selected as this may also affect the associated vibrations depending on rotorcraft type. The associated motion effects for the above tests should also include an assessment of the effects of rolling over centerline lights, surface discontinuities of uneven runways, and various taxiway characteristics.	
2.	Friction Drag from Skid-type Landing Gear: Procedure: Perform a running takeoff or a running landing and note an increase in a fuselage vibration (as opposed to rotor vibration) due to the friction of dragging the skid along the surface. This vibration will lessen as the ground speed decreases.		X	X		
3.	Rotor Out-of-Track and/or Out-of-Balance condition: Procedure: Select the malfunction or condition from the IOS. Start the engine(s) normally and check for an abnormal vibration for an Out-of-Track condition and check for an abnormal vibration for an Out-of-Balance condition.	X	X	X	Does not require becoming airborne. The abnormal vibration for Out-of-Track and Out-of-Balance conditions should be recognized in the frequency range of the inverse of the period for each; i.e., 1/P for vertical vibration, and 1/P for lateral vibration.	
4.	Bumps associated with the landing gear: Procedure: Perform a normal take-off paying special attention to the bumps that could be perceptible due to maximum oleo extension after lift-off.	X	X	X	When the landing gear is extended or retracted, motion bumps can be felt when the gear locks into position.	
5.	Buffet during extension and retraction of landing gear: Procedure: Operate the landing gear. Check that the motion cues of the buffet experienced represent the actual rotorcraft.	X	X	X		

Table B3D – Rotorcraft - Functions and Subjective Tests – Motion System

Entry No.	Rotorcraft Motion System (and Special Aerodynamic Model) Effects	Simulator Level			Notes/Information
		B	C	D	
6.	Failure of Dynamic Vibration Absorber or similar system as appropriate for the rotorcraft (e.g., droop stop or static stop): Procedure: May be accomplished any time the rotor is engaged. Select the appropriate failure at the IOS, note an appropriate increase in vibration and check that the vibration intensity and frequency increases with an increase in RPM and an increase in collective application.	X	X	X	
7.	Tail Rotor Drive Failure: Procedure: With the engine(s) running and the rotor engaged – select the malfunction and note the immediate increase of medium frequency vibration.	X	X	X	The tail rotor operates in the medium frequency range, normally estimated by multiplying the tail rotor gear box ratio by the main rotor RPM. The failure can be recognized by an increase in the vibrations in this frequency range.
8.	Touchdown cues for main and nose gear: Procedure: Conduct several normal approaches with various rates of descent. Check that the motion cues for the touchdown bumps for each descent rate are representative of the actual rotorcraft.	X	X	X	
9.	Tire failure dynamics: Procedure: Simulate a single tire failure and a multiple tire failure.		X	X	The pilot may notice some yawing with a multiple tire failure selected on the same side. This should require the use of the pedal to maintain control of the rotorcraft. Dependent on rotorcraft type, a single tire failure may not be noticed by the pilot and may not cause any special motion effect. Sound or vibration may be associated with the actual tire losing pressure.
10.	Engine malfunction and engine damage: Procedure: The characteristics of an engine malfunction as prescribed in the malfunction definition document for the particular flight simulator must describe the special motion effects felt by the pilot. Note the associated engine instruments varying according to the nature of the malfunction and note the replication of the effects of the airframe vibration.	X	X	X	
11.	Tail boom strikes: Procedure: Tail-strikes can be checked by over-rotation of the rotorcraft at a quick stop or autorotation to the ground.	X	X	X	The motion effect should be felt as a noticeable nose down pitching moment.

Table B3D – Rotorcraft - Functions and Subjective Tests – Motion System

Entry No.	Rotorcraft Motion System (and Special Aerodynamic Model) Effects	Simulator Level			Notes/Information
		B	C	D	
12.	Vortex Ring State (Settling with Power): Procedure: Specific procedures may differ between rotorcrafts and may be prescribed by the Rotorcraft Manufacturer or other subject matter expert. However, the following information is provided for illustrative purposes ...To enter the maneuver, reduce power below hover power. Hold altitude with aft cyclic until the airspeed approaches 20 knots. Then allow the sink rate to increase to 300 feet per minute or more as the attitude is adjusted to obtain an airspeed of less than 10 knots.		X	X	When the aircraft begins to shudder, the application of additional up collective increases the vibration and sink rate. One recovery method is to decrease collective to enter vertical autorotation and/or use cyclic inputs to gain horizontal airspeed and exit from vortex ring state.
13.	Retreating Blade Stall: Procedure: Specific procedures may differ between rotorcrafts and may be prescribed by the Rotorcraft Manufacturer or other subject matter expert. However, the following information is provided for illustrative purposes: To enter the maneuver, increase forward airspeed; the effect will be recognized through the development of a low frequency vibration, pitching up of the nose, and a roll in the direction of the retreating blade. High weight, low rotor RPM, high density altitude, turbulence or steep, abrupt turns are all conducive to retreating blade stall at high forward airspeeds.		X	X	Correct recovery from retreating blade stall requires the collective to be lowered first, which reduces blade angles and the angle of attack. Aft cyclic can then be used to slow the rotorcraft.
14.	Translational Lift Effects: Procedure: From a stabilized in-ground-effect (IGE) Hover begin a forward acceleration. When passing through the effective translational lift range, the noticeable effect will be a possible nose pitch-up in some rotorcrafts, an increase in the rate of climb, and a temporary increase in vibration level (in some cases this vibration may be pronounced). This effect is experienced again upon deceleration through the appropriate speed range. During deceleration, the pitch and rate of climb will have the reverse effect, but there will be a similar, temporary increase in vibration level.	X	X	X	None

Table B3E – Rotorcraft - Sound System - Functions and Subjective Tests

Table B3E – Rotorcraft Sound System - Functions and Subjective Tests				
Entry No.	Rotorcraft Sound System	Simulator Level		
		B	C	D
The following checks are performed during a normal flight profile, motion system ON				
1.	Precipitation.		X	X
2.	Rain removal equipment.		X	X
3.	Helicopter noises used by the pilot for normal helicopter operation.		X	X
4.	Abnormal operations for which there are associated sound cues, including engine malfunctions, landing gear or tire malfunctions, tail boom.		X	X
5.	Sound of a crash when the flight simulator is landed in excess of limitations.		X	X

Table B3F – Rotorcraft – Special Effects - Functions and Subjective Tests

Table B3E – Rotorcraft Special Effects - Functions and Subjective Tests				
Entry No.	Rotorcraft Special Effects	Simulator Level		
		B	C	D
This table specifies the minimum special effects necessary for the specified simulator level.				
1.	Braking Dynamics: Representations of the dynamics of brake failure (flight simulator pitch, side-loading, and directional control characteristics representative of the helicopter), including antiskid and decreased brake efficiency due to high brake temperatures (based on helicopter related data), sufficient to enable pilot identification of the problem and implementation of appropriate procedures.		X	X
2.	Effects of Airframe and Engine Icing: Required only for those helicopters authorized for operations in known icing conditions. Procedure: With the simulator airborne, in a clean configuration, nominal altitude and cruise airspeed, autopilot on and auto-throttles off, engine and airfoil anti-ice/de-ice systems deactivated; activate icing conditions at a rate that allows monitoring of simulator and systems response. Icing recognition will include an increase in gross weight, airspeed decay, change in simulator pitch attitude, change in engine performance indications (other than due to airspeed changes), and change in data from pitot/static system, or rotor out-of-track/balance. Activate heating, anti-ice, or de-ice systems independently. Recognition will include proper effects of these systems, eventually returning the simulated helicopter to normal flight.		X	X

Table B3G – Rotorcraft – Instructor Operating System (IOS) - Functions and Subjective Tests

Table B3E – Rotorcraft Instructor Operating System (IOS) - Functions and Subjective Tests				
Entry No.	Rotorcraft Instructor Operating System (IOS)	Simulator Level		
		B	C	D
This table specifies the minimum special effects necessary for the specified simulator level.				
1.	Simulator Power Switch(es)	X	X	X
2.	Helicopter conditions.			
2.a.	Gross weight, center of gravity, fuel loading and allocation	X	X	X
2.b.	Helicopter systems status.	X	X	X
2.c.	Ground crew functions	X	X	X
3.	Airports / Heliports.			
3.a.	Number and selection.	X	X	X
3.b.	Runway or landing area selection.	X	X	X
3.c.	Landing surface conditions (rough, smooth, icy, wet, dry, snow)	X	X	X
3.d.	Preset positions	X	X	X
3.e.	Lighting controls.	X	X	X
4.	Environmental controls.			
4.a.	Visibility (statute miles / kilometers).	X	X	X
4.b.	Runway visual range (in feet / meters).	X	X	X
4.c.	Temperature.	X	X	X
4.d.	Climate conditions	X	X	X
4.e.	Wind speed and direction.	X	X	X
5.	Helicopter system malfunctions (Insertion / deletion).	X	X	X
6.	Locks, Freezes, and Repositioning.			
6.a.	Problem (all) freeze / release.	X	X	X
6.b.	Position (geographic) freeze / release.	X	X	X
6.c.	Repositioning (locations, freezes, and releases).	X	X	X
6.d.	Ground speed control.	X	X	X
7.	Remote IOS.	X	X	X
8.	Sound Controls. On / off / adjustment	X	X	X
9.	Motion / Control Loading System.			
9.a.	On / off / emergency stop.	X	X	X
10.	Observer Seats / Stations. Position / Adjustment / Positive restraint system.	X	X	X

Attachments to Chapter 4

Attachment 4.1 - Sample Validation Data Roadmap (VDR)

ICAO or IATA #	Test Description	Validation Source			Validation Document						Comments
		CCA Mode	Aircraft Flight Test Data	Engineering Simulator Data (DEF-73 Engines)	Aerodynamics POM Doc. #xxx123, Rev. A	Flight Controls POM Doc. #xxx456, NEW	Ground Handling POM Doc. #xxx789, Rev. B	Propulsion POM Doc. #321, Rev. C	Integrated POM Doc. #xxx654, Rev. A	Appendix to this VDR Doc. #xxx987, NEW	
ICAO or IATA #	Notes: 1. Only one page is shown; and some test conditions were deleted for brevity. 2. Relevant regulatory material should be consulted and all applicable tests addressed. 3. Validation source, document and comments provided herein are for reference only and do not constitute approval for use. 4. CCA mode must be described for each test condition. 5. If more than one aircraft type (e.g., derivative and baseline) are used as validation data more columns may be necessary.										Legend: D71 = Engine Type (Thrust Rating of 71.5K) D73 = Engine Type (Thrust Rating of 73K) Bold upper case = primary validation source. Lower case, within parentheses = alternative validation source. R = Rationale included in the data package Appendix.
	1.a.1 Minimum Radius Turn.		X				D71				
	1.a.2 Rate of Turn vs. Nosewheel Angle (2 speeds).		X				D71				
	1.b.1 Ground Acceleration Time and Distance		X				(d73)		D73		Primary data contained in IPOM.
	1.b.2 Minimum Control Speed, Ground (Vmcg).		(x)		(d71)					D73	See engineering rationale for test data in VDR
	1.b.3 Minimum Unstick Speed (Vmu).		X		D71						
	1.b.4 Normal Takeoff.		X		(d73)				D73		Primary data contained in IPOM.
	1.b.5 Critical Engine Failure on Takeoff.		X		(d71)					D73	Alternative engine thrust rating flight test data in VDR.
	1.b.6 Crosswind Takeoff.		X		(d71)					D73	Alternative engine thrust rating flight test data in VDR.
	1.b.7 Rejected Takeoff.		X		D71					R	Test procedure anomaly; see rationale.
	1.b.8 Dynamic Engine Failure After Takeoff.			X						D73	No flight test data available; see rationale.
	1.c.1 Normal Climb – All Engines.		X		(d71)						Primary data contained in IPOM.
	1.c.2 Climb – Engine-out, Second Segment.		X		(d71)					D73	Alternative engine thrust rating flight test data in VDR.
	1.c.3 Climb – Engine-out, Enroute.		X		(d71)					D73	AFM data available (73K).
	1.c.4 Engine-out, Approach Climb.		X		D71						

1.c.5.a	Level Flight Acceleration.		(x)	X	(d73)					D73	Eng sim data w/ modified EEC accel rate in VDR.
1.c.5.b	Level Flight Deceleration.		(x)	X	(d73)					D73	Eng sim data w/ modified EEC accel rate in VDR.
1.d.1	Cruise Performance.		X		D71					(d73)	
1.e.1.a	Stopping Time & Distance (Wheel brakes / Light weight).			X	D71					(d73)	No flight test data available; see rationale.

Attachment 4.2 – Guidance for planning Functions and Subjective Testing.**Introduction**

1. The following is an example test schedule for an Initial/Upgrade evaluation that covers the majority of the requirements set out in the Functions and Subjective test requirements (for Aeroplanes only). It is not intended that the schedule be followed line by line, rather, the example should be used as a guide for preparing a schedule that is tailored to the airplane or rotorcraft sponsor and training tasks.
2. Functions and subjective tests should be planned. This information has been organized as a reference document with the considerations, methods, and evaluation notes for each individual aspect of the simulator task presented as an individual item. In this way the evaluator can design his or her own test plan, using the appropriate sections to provide guidance on method and evaluation criteria. Two aspects should be present in any test plan structure:
 - a. An evaluation of the simulator to determine that it replicates the aircraft and performs reliably for an uninterrupted period equivalent to the length of a typical training session.
 - b. The simulator should be capable of operating reliably after the use of training device functions such as repositions or malfunctions.
3. A detailed understanding of the training task will naturally lead to a list of objectives that the simulator should meet. This list will form the basis of the test plan. Additionally, once the test plan has been formulated, the initial conditions and the evaluation criteria should be established. The evaluator should consider all factors that may have an influence on the characteristics observed during particular training tasks in order to make the test plan successful.

Events (Aeroplanes)

1. Initial Conditions.

- Airport.
- QNH.
- Temperature.
- Wind/Crosswind.
- Zero Fuel Weight/Fuel/Gross Weight/Center of Gravity.

2. Initial Checks.

- Documentation of Simulator.
 - Simulator Acceptance Test Manuals.
 - Simulator Approval Test Guide.
 - Technical Logbook Open Item List.
 - Daily Functional Pre-flight Check.
 - Documentation of User/Carrier Flight Logs.
 - Simulator Operating/Instructor Manual.
 - Difference List (Aircraft/Simulator).
 - Flight Crew Operating Manuals.
 - Performance Data for Different Fields.
 - Crew Training Manual.
 - Normal/Abnormal/Emergency Checklists.
 - Simulator External Checks.
 - Appearance and Cleanliness.
 - Stairway/Access Bridge.
 - Emergency Rope Ladders.
 - "Motion On"/"Flight in Progress" Lights.
 - Simulator Internal Checks.
 - Cleaning/Disinfecting Towels (for cleaning oxygen masks).
 - Flight deck Layout (compare with difference list).
 - Equipment.
 - Quick Donning Oxygen Masks.
 - Head Sets.
 - Smoke Goggles.
 - Sun Visors.
 - Escape Rope.
 - Chart Holders.
 - Flashlights.
 - Fire Extinguisher (inspection date).
 - Crash Axe.
 - Gear Pins.
- ### 3. Power Supply and APU Start Checks.
- Batteries and Static Inverter.
 - APU Start with Battery.
 - APU Shutdown using Fire Handle.
 - External Power Connection.
 - APU Start with External Power.
 - Abnormal APU Start/Operation.
- ### 4. Flight deck Checks.
- Flight deck Preparation Checks.
 - FMC Programming.
 - Communications and Navigational Aids Checks.
- ### 5. Engine Start.
- Before Start Checks.
 - Battery start with Ground Air Supply Unit.
 - Engine Crossbleed Start.
 - Normal Engine Start.
 - Abnormal Engine Starts.
 - Engine Idle Readings.
 - After Start Checks.
- ### 6. Taxi Checks.
- Pushback/Powerback.
 - Taxi Checks.
 - Ground Handling Check:
 - Power required to initiate ground roll.
 - Thrust response.
 - Nosewheel and Pedal Steering.
 - Nosewheel Scuffing.
 - Perform 180 degree turns.
 - Brakes Response and Differential Braking using Normal, Alternate and Emergency.
 - Brake Systems.
 - Eye height and fore/aft position.
 - Runway Roughness.
- ### 7. Visual Scene—Ground Assessment.
- Select 3 different airport models and perform the following checks with Day, Dusk and Night selected, as appropriate:
- Visual Controls.
 - Daylight, Dusk, Night Scene Controls.

- Flight deck "Daylight" ambient lighting.
 - Environment Light Controls.
 - Runway Light Controls.
 - Taxiway Light Controls.
- Airport Model Content.
 - Ramp area for buildings, gates, air bridges, maintenance ground Equipment, parked aircraft.
 - Daylight shadows, night time light pools.
 - Taxiways for correct markings, taxiway/runway, marker boards, CAT I and II/III hold points, taxiway shape/grass areas, taxiway light (positions and colors).
 - Runways for correct markings, lead-off lights, boards, runway slope, runway light positions, and colors, directionality of runway lights.
 - Airport environment for correct terrain and significant features.
 - Visual scene quantization (aliasing), color, and occulting levels.
 - Ground Traffic Selection.
 - Environment Effects.
 - Low cloud scene.
 - Rain / Hail effects:
 - Runway surface scene and
 - Windshield wiper - operation and sound.
 - Lightning/thunder.
 - Snow/ice runway surface scene.
 - Fog.

8. Takeoff.

Select one or several of the following test cases:

- T/O Configuration Warnings.
- Engine Takeoff Readings.
- Rejected Takeoff (Dry/Wet/Icy Runway) and check the following:
 - Autobrake function.
 - Anti-skid operation.
 - Motion/visual effects during deceleration.
 - Record stopping distance (use runway plot or runway lights

- remaining). Continue taxiing along the runway while applying brakes and check the following:
- Center line lights alternating red/white for 2000 feet/600 meters.
 - Center line lights all red for 1000 feet/300 m.
 - Runway end, red stop bars.
 - Braking fade effect.
 - Brake temperature indications.
 - Engine Failure between V1 and V2
- Normal Takeoff:
 - During ground roll check the following:
 - Runway rumble.
 - Acceleration cues.
 - Groundspeed effects.
 - Engine sounds.
 - Nosewheel and rudder pedal steering.
 - During and after rotation, check the following:
 - Rotation characteristics.
 - Column force during rotation.
 - Gear uplock sounds/bumps.
 - Effect of slat/flap retraction during climbout.
 - Crosswind Takeoff (check the following):
 - Tendency to turn into or out of the wind.
 - Tendency to lift upwind wing as airspeed increase.
 - Windshear during Takeoff (check the following):
 - Controllable during windshear encounter.
 - Performance adequate when using correct techniques.
 - Windshear Indications satisfactory.
 - Motion cues satisfactory (particularly turbulence).
 - Normal Takeoff with Control Malfunction
 - Low Visibility T/O (check the following):
 - Visual cues.
 - Flying by reference to instruments.
 - SID Guidance on LNAV.

9. Climb Performance.

Select one or several of the following test cases:

- a) Normal Climb—Climb while maintaining recommended speed profile and note fuel, distance and time.
- a) Single Engine Climb—Trim aircraft in a zero wheel climb at V₂.
Note: Up to 5° bank towards the operating engine(s) is permissible. Climb for 3 minutes and note fuel, distance, and time. Increase speed toward enroute climb speed and retract flaps. Climb for 3 minutes and note fuel, distance, and time.

10. Systems Operation during Climb.

Check normal operation and malfunctions as appropriate for the following systems:

- a) Air conditioning/Pressurization/Ventilation.
- b) Autoflight.
- c) Communications.
- d) Electrical.
- e) Fuel.
- f) Icing Systems.
- g) Indicating and Recording systems.
- h) Navigation/FMS.
- i) Pneumatics.

11. Cruise Checks.

Select one or several of the following test cases:

- a) Cruise Performance.
- b) High Speed/High Altitude Handling (check the following):
 - Overspeed warning.
 - High Speed buffet.
 - Aircraft control satisfactory.
 - Envelope limiting functions on Computer Controlled Aircraft. Reduce airspeed to below level flight buffet onset speed, start a turn, and check the following:

- High Speed buffet increases with G loading.
- Reduce throttles to idle and start descent, deploy the speedbrake, and check the following:
 - Speedbrake indications.
 - Symmetrical deployment.
 - Airframe buffet.
 - Aircraft response hands off.
- c) Yaw Damper Operation. Switch off yaw dampers and autopilot. Initiate a Dutch roll and check the following:
 - Aircraft dynamics.
 - Simulator motion effects. Switch on yaw dampers, re-initiate a Dutch roll and check the following:
 - Damped aircraft dynamics.

- d) APU Operation.
- e) Engine Gravity Feed.
- f) Engine Shutdown and Driftdown Check: FMC operation Aircraft performance.
- g) Engine Relight.

12. Descent.

Select one of the following test cases:

- a) Normal Descent Descend while maintaining recommended speed profile and note fuel, distance And time.
- b) Cabin depressurization / Emergency Descent.

13. Medium Altitude Checks.

Select one or several of the following test cases:

- a) High Angle of Attack/Stall. Trim the aircraft at 1.4 V_s, establish 1 kt/sec² deceleration rate, and check the following:
 - System displays/operation satisfactory.
 - Handling characteristics satisfactory.
 - Stall and Stick shaker speed.
 - Buffet characteristics and onset speed.
 - Envelope limiting functions on Computer Controlled Aircraft.
 - Recover to straight and level flight and check that handling

characteristics are satisfactorily restored.

- b) Turning Flight. Roll aircraft to left, establish a 30° to 45° bank angle, and check the following:
 - Stick force required, satisfactory.
 - Wheel input to maintain bank angle.
 - Slip ball response, satisfactory.
 - Time to turn 180°.
 - Roll aircraft from 45° bank one way to 45° bank the opposite direction while maintaining altitude and airspeed—check controllability during maneuver.
- c) Degraded flight controls.
- d) Holding Procedure - check the following:
 - FMC operation.
 - Autopilot auto thrust performance.
- e) Storm Selection - check the following:
 - Weather radar controls.
 - Weather radar operation.
 - Visual scene corresponds with WXR pattern.
 - Fly through storm center, and check the following :
 - Aircraft enters cloud.
 - Aircraft encounters representative turbulence.
 - Rain/hail sound effects evident.
 - As aircraft leaves storm area, check that storm effects disappear.
- f) TCAS - check:
 - Traffic appears on visual display.
 - Traffic appears on TCAS display(s). As conflicting traffic approaches, take relevant avoiding action, and check appropriate response of visual and TCAS system displays.

14. Approach and Landing.

Select one or several of the following test cases while monitoring flight control and hydraulic systems for normal operation and with malfunctions selected:

- a) Flaps/Gear Normal Operation. Check the following:
 - Time for extension/retraction.
 - Buffet characteristics.
- b) Normal Visual Approach and Landing. Fly a normal visual approach and landing—check the following:
 - Aircraft handling.
 - Spoiler operation.
 - Reverse thrust operation.
 - Directional control on the ground.
 - Touchdown cues for main and nosewheel.
 - Visual cues.
 - Motion cues.
 - Sound cues.
 - Brake and Anti-skid operation.
- c) Flaps/Gear Abnormal Operation or with hydraulic malfunctions.
- d) Abnormal Wing Flaps/Slats Landing.
- e) Manual Landing with Control Malfunction.
 - Aircraft handling.
 - Radio Aids and instruments.
 - Airport model content and cues.
 - Motion cues.
 - Sound cues.
- f) Non-precision Approach—All Engines Operating.
 - Aircraft handling.
 - Radio Aids and instruments.
 - Airport model content and cues.
 - Motion cues.
 - Sound cues.
- g) Circling Approach.
 - Aircraft handling.
 - Radio Aids and instruments.
 - Airport model content and cues.
 - Motion cues.
 - Sound cues.
- h) Non-precision Approach—One Engine Inoperative.
 - Aircraft handling.
 - Radio Aids and instruments.
 - Airport model content and cues.
 - Motion cues.
 - Sound cues.
- i) One Engine Inoperative Go-around.

• Aircraft handling. • Radio Aids and instruments. • Airport model content and cues. • Motion cues. • Sound cues. j) CAT I Approach and Landing with raw-data ILS. • Aircraft handling. • Radio Aids and instruments. • Airport model content and cues. • Motion cues. • Sound cues. k) CAT I Approach and Landing with Limiting Crosswind. • Aircraft handling. • Radio Aids and instruments. • Airport model content and cues. • Motion cues. • Sound cues. l) CAT I Approach with Windshear. Check the following: • Controllable during windshear encounter. • Performance adequate when using correct techniques. • Windshear indications/warnings. • Motion Cues (particularly turbulence). m) CAT II Approach and Automatic Go-Around. n) CAT III Approach and Landing—System Malfunctions. o) CAT III Approach and Landing—One Engine Inoperative. p) GPWS evaluation.	Airport model content as described below: <u>Visual Controls.</u> • Daylight, Dusk, Night Scene Controls. • Environment Light Controls. • Runway Light Controls. • Taxiway Light Controls. • Approach Light Controls. <u>Airport model Content.</u> • Airport environment for correct terrain and significant features. • Runways for correct markings, runway slope, directionality of runway lights. • Visual scene for quantization (aliasing), color, and occulting. b) Reposition the aircraft to a long, final approach for an “ILS runway.” Select flight freeze when the aircraft is 5-statute miles (sm)/8-kilometers (km) out and on the glide slope. Check airport model content for the following: • Airfield features. • Approach lights. • Runway definition. • Runway definition. • Runway edge lights and VASI lights. • Strobe lights. Release flight freeze. c) Continue flying the approach with NP engaged. Select flight freeze when aircraft is 3 sm/5 km out and on the glide slope. Check airport model content for the following:: • Runway centerline light. • Taxiway definition and lights. d) Release flight freeze and continue flying the approach with A/P engaged. Select flight freeze when aircraft is 2 sm/3 km out and on the glide slope. Check airport model content for the following: • Runway threshold lights.	• Touchdown zone lights. e) At 200 ft radio altitude and still on glide slope, select Flight Freeze. Check airport model content for the following: • Runway markings. f) Set the weather to Category I conditions and Check airport model content for the following: • Visual ground segment. g) Set the weather to Category II conditions, release Flight Freeze, and re-select Flight. Freeze at 100 feet radio altitude, and check airport model content for the following: • Visual ground segment. h) Select night/dusk (twilight) conditions and check the airport model content the following: • Runway markings visible within landing light lobes. i) Set the weather to Category III conditions, release Flight Freeze, re-select Flight Freeze at 50 feet radio altitude and check airport model content for the following:: • Visual ground segment. j) Set WX to a typical “missed approach” weather condition, release Flight Freeze, reselect Flight Freeze at 15 feet radio altitude, and check airport model content for the following:: • Visual ground segment. k) When on the ground, stop the aircraft. Set 0 feet RVR, ensure strobe/beacon lights are switched on and check airport model content for the

15. Visual Scene - In-Flight Assessment.

Select three (3) different visual models and perform the following checks with “day,” “dusk,” and “night” (as appropriate) selected.

- a) Reposition the aircraft at or below 2000 feet within 10 nm of the airfield. Fly the aircraft around the airport environment and assess control of the visual system and evaluate the

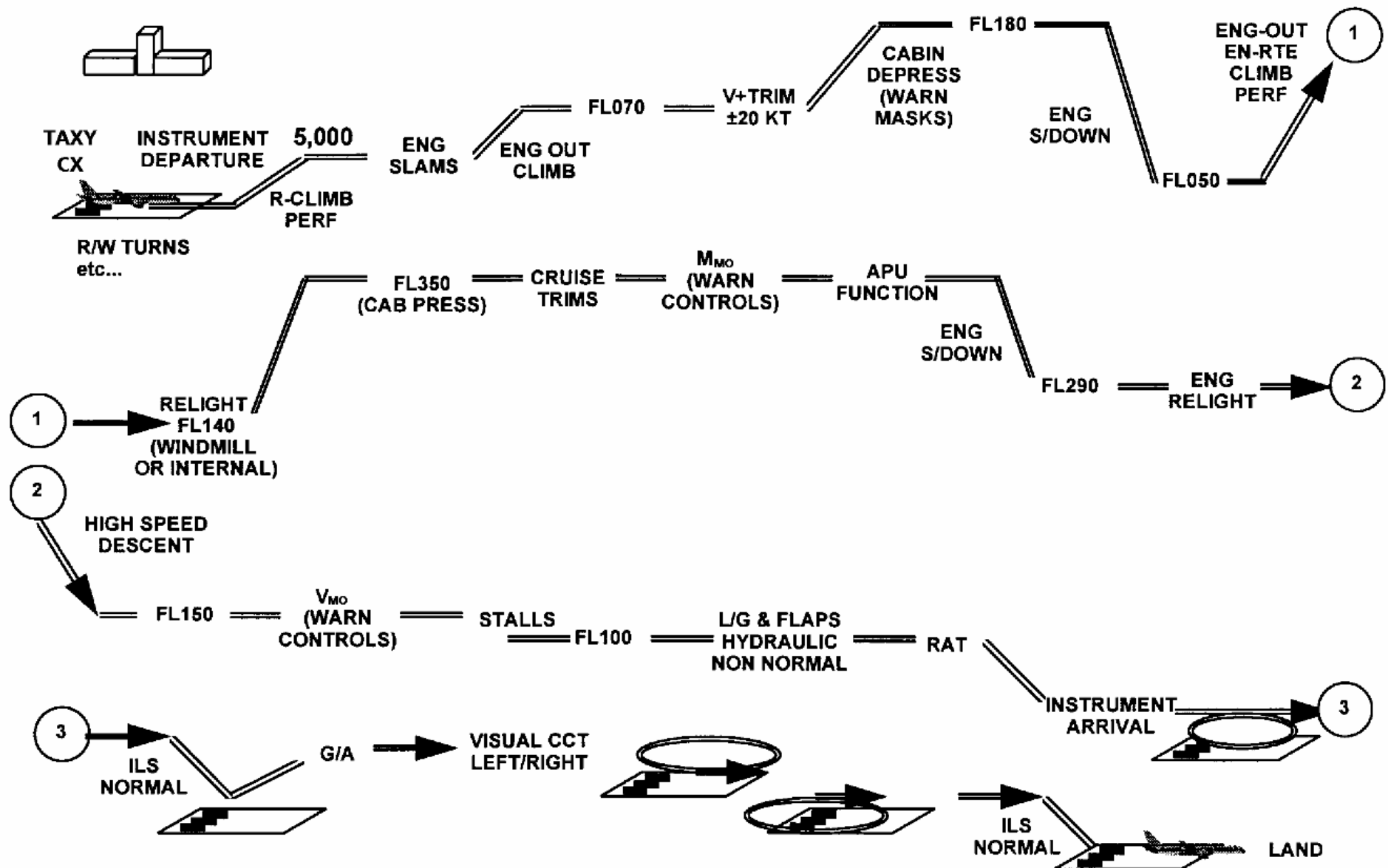


Figure 1 - Subjective Evaluation Flight Profile for Aeroplanes

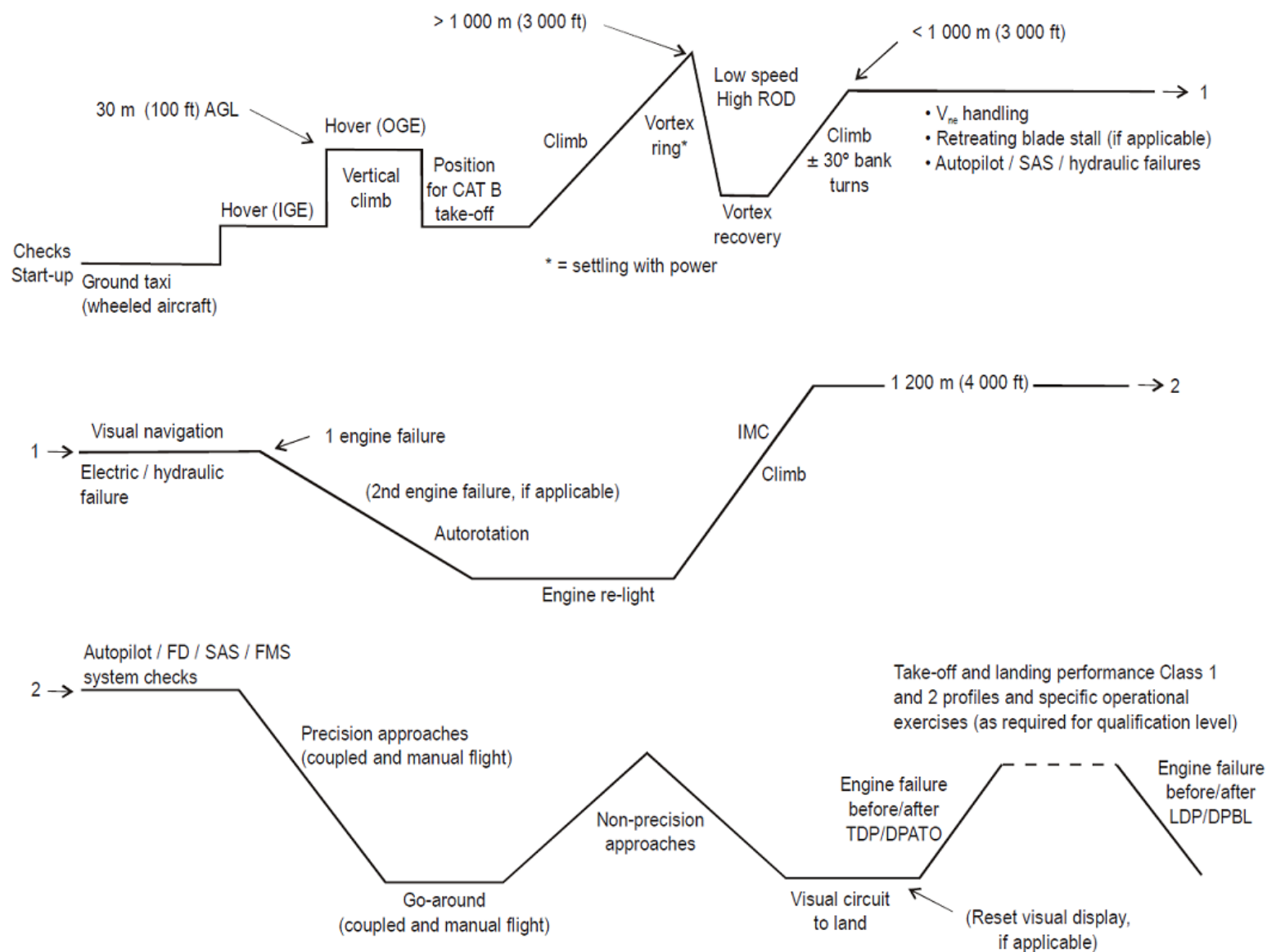


Figure 2 - Sample Subjective Evaluation Flight Profile for Rotorcraft.

Chapter 5 - Type-Specific Flight Training Device (FTD) - Qualification Performance Standards

5.1 Overview

- 5.1.1 This chapter describes the qualification performance standards (QPS) for **aeroplane** and **rotorcraft** flight Training Devices (FTD) (Level 4 to Level 7). Whenever the term “**aircraft**” is used, it pertains to both aeroplanes and rotorcraft. The main body of Chapter 5 pertains to **aircraft** FSTDs. The technical requirements and evaluation criteria specific to aeroplane and rotorcraft FSTDs are presented in the following appendices and tables:

A. AEROPLANE FTD - QPS

- a. Appendix C1 – Aeroplane FTD – General Simulator Requirements
- b. Appendix C2 – Aeroplane FTD – Objective Test Requirements
- c. Appendix C3 – Aeroplane FTD – Simulator Subjective Evaluations

B. ROTORCRAFT FTD - QPS

- d. Appendix D1 – Rotorcraft FTD – General Simulator Requirements
- e. Appendix D2 – Rotorcraft FTD – Objective Test Requirements
- f. Appendix D3 – Rotorcraft FTD – Simulator Subjective Evaluations

ATTACHMENTS:

5.2 General Description of Type-Specific Flight Training Device

- 5.2.1 Detailed standards and tests for the various levels of FTDs are fully defined in Appendices C1, C2 and C3 for aeroplanes and Appendices D1, D2 and D3 for rotorcraft.

- a. **Level 4.** A Level 4 FTD may have an open aircraft-specific flight deck area, or an enclosed aircraft-specific flight deck and at must have at least one operating system. Air/ground logic is required (no aerodynamic programming required). All displays may be flat/LCD panel representations or actual representations of displays in the aircraft. All controls, switches, and knobs may be touch sensitive activation (not capable of manual manipulation of the flight controls) or may physically replicate the aircraft in control operation.

Note: Level 4 FTDs are qualified for procedural training only. If the FTD includes physical replication of primary flight controls and switches/knobs for automated flight control inputs (i.e. Flight control units / FMS), the Manager, Simulator Program (MSP) may recommend credit for specific training task, which may potentially reduce the required time in a Full Flight Simulator (FFS). Final approval for credits in an approved training program will rest solely with the Training Program Approval Authority (TPAA). The evaluation will consider the subjective performance of the aerodynamic flight model and whether the physical controls used in the training task fully support an effective pilot skill transfer to the FFS. Further Guidance is provided in at Section 5.10 FTD Level 4 – Subjective Evaluation Method.

- b. **Level 5.** A Level 5 FTD may have an open aircraft-specific flight deck area, or an enclosed aircraft-specific flight deck and a generic aerodynamic program. It must have at least one operating system, and control loading representative of the simulated aircraft. The control loading need only represent the aircraft at approach speed and configuration. All displays may be flat/LCD panel representations or actual representations of displays in the aircraft. Primary and secondary flight controls (e.g. rudder; aileron; elevator; flaps; spoilers/speed brakes; engine controls; landing gear; nose-wheel steering; trim; brakes) must be physical controls. All other controls, switches, and knobs may be touch sensitive activation.

- c. **Level 6.** A Level 6 device is one that has an enclosed aircraft-specific flight deck and aerodynamic program with all applicable aircraft systems operating and control loading that is representative of the simulated aircraft throughout its ground and flight envelope and significant sound representation. All displays may be flat/LCD panel representations or actual representations of displays in the aircraft, but all controls, switches, and knobs must physically replicate the aircraft in control operation.
- d. **Level 7.** A level 7 FTD has an enclosed aircraft-specific flight deck and aerodynamic program with all applicable aircraft systems operating and control loading that is representative of the simulated aircraft throughout its ground and flight envelope and significant sound representation. All displays may be flat/LCD panel representations or actual representations of displays in the aircraft, but all controls, switches, and knobs must physically replicate the aircraft in control operation. Additional requirements are as follows:
 - 1) **Aeroplane FTDs** must have a visual system that provides an out-of-the-flight deck view, providing cross-flight deck viewing (for both pilots simultaneously) of a field-of-view of at least: 180° horizontally and 40° vertically;
 - 2) **Rotorcraft FTDs** must have a visual system that provides an out-of-the-flight deck view, providing cross-flight deck viewing (for both pilots simultaneously) of a field-of-view of at least: 146° horizontally and 36° vertically; and a vibration cueing system for characteristic rotorcraft vibrations noted at the pilot station(s).

5.3 Flight Test Validation Data

5.3.1 The requirements for gathering flight test data to validate FTD objective tests are the same as those for an FFS and can be found in Chapter 4, Section 4.2. The accuracy and resolution of the flight test data must be sufficient to clearly determine compliance with objective test criteria in Appendix C2, Table C2C for aeroplane FTDs or Appendix D2 Table D2C for rotorcraft FTDs.

5.3.2 **Level 7 FTD** objective tests must be validated using flight test data that has been gathered in accordance with a flight test program.

5.3.3 **Level 6 FTD** objective tests must be validated using flight test data that has been gathered in accordance with a flight test program. For Level 6 aeroplane FTDs, a sponsor may choose to use one or more of the alternative sources, procedures, and instrumentation described in Table C2C

Note: Guidance and conditions for using the alternate sources for Level 6 aeroplane FTDs can be found in the preamble to Table C2C.

5.3.4 **Level 5 FTD** may be qualified based on generic aerodynamic programming that represents the set of aircraft in which the aircraft type simulated belongs. For rotorcraft FTDs and large aeroplanes FTDs (operating under CAR Part VI and VII), objective tests must be compared with flight test data that have been gathered in accordance with a flight test program. For small aeroplane FTDs (operating under CAR Part IV), the aerodynamic model and handling qualities may be validated using alternative data source and procedures found in Appendix C2, Table C2B – Level 5 FTD - Alternative Data Source for Small, Single and Multi-Engine Aeroplanes.

Note: “Class” in relation to the classification of aeroplanes, means aeroplanes having similar operating characteristics to single-engine aeroplanes, multi-engine aeroplanes, centre-line thrust aeroplanes, land aeroplanes or sea aeroplanes.

Note: Guidance for applying alternate data sources for Level 5 aeroplane FTDs can be found in the preamble to Table C2B.

Note: “Set of Aircraft” is a group or series of aircraft group that share similar handling and operating characteristics, similar operating envelopes, and have the same number and type of engines or power-plants.

Note: “Small aeroplane” — means an aeroplane having a maximum permissible take-off weight of 5 700 kg (12,566 pounds) or less.

- 5.3.5 **Level 4 FTD** qualifications do not require validation data. The aerodynamic model performance and handling qualities are evaluated subjectively with specific focus on the tasks that the sponsor intends to train using the device. The sponsor will identify the intended training tasks in the application process. Further guidance is provided in at Section 5.10 *FTD Level 4 – Subjective Evaluation Method*.

5.4 Engineering Simulator—Validation Data

- 5.4.1 When a fully validated FTD (i.e. validated with flight test results) is modified due to changes to the simulated aircraft configuration, the aircraft manufacturer or other acceptable data supplier may coordinate with the MSP to supply validation data from an “audited” engineering simulator/simulation to selectively supplement flight test data. The MSP must be provided an opportunity to audit the use of the engineering simulation or the engineering simulator during the acquisition of the data that will be used as validation data. Engineering data may be used for changes that are incremental in nature. Manufacturers or other data suppliers must be able to demonstrate that the predicted changes in aircraft performance are based on acceptable aeronautical principles with proven success history and valid outcomes. This must include comparisons of predicted and flight test validated data.
- 5.4.2 The complete requirements for using engineering data are the same as those for a FFS and can be found in Chapter 4, Section 4.3.

5.5 Validation Test Tolerances - Non-Flight-Test Data

- 5.5.1 The objective-test tolerances listed in Appendix C2, Table C2A (aeroplanes) and Appendix D2, Table D2A (rotorcraft) provide a measureable means to compare and assess simulator performance against data acquired through actual flight-tests. Good engineering judgment should be applied to all tolerances in any test. A test fails when the results fall outside of the prescribed tolerance(s).
- 5.5.2 In some cases, engineering simulator data or other non-flight-test data sources may be considered if sound technical reasons or high costs prohibit the acquisition of flight-test data, or if alternative technical solutions are being proposed. If the use engineering data or non-flight-test data is allowed, then the data provider must supply a well-documented mathematical model and test procedure.
- 5.5.3 Engineering simulator data is deemed acceptable since the same simulation models used to generate the reference data are also used to test the FTD. The expected test results from both devices should therefore be very similar. For this reason, the expected tolerance for FTD objective tests validated using engineering data is reduced to 40% of those tolerances published in this manual for corresponding tests using flight-test data. However, there may be circumstances where the simulator models employed, or the manner in which they are integrated in the test loop, yield a higher fidelity than those supplied by the data provider. In these cases, it is possible that an error greater than 40% may be acceptable if the sponsor can provide adequate explanation. The MSP may accept that the results from the two sources exceed 40% tolerance band based on justification relating to:
- Hardware (avionics units and flight controls);
 - Iteration rates;
 - Execution order;
 - Integration methods;
 - Processor architecture;
 - Digital drift, including:
 - Interpolation methods;
 - Data handling differences; or
 - Auto-test trim tolerances.

5.6 Validation Data Roadmap

- 5.6.1 A Validation Data Roadmap (VDR) is a document that contains guidance material from the data supplier recommending the best possible sources of data to be used as validation data in the Qualification Test Guide (QTG). For Level 6 and 7 FTDS, aircraft manufacturers or other data suppliers must supply a VDR as part of the FSTD validation data package. A VDR is of special value when requesting an interim qualification, a qualification for simulators of aircrafts certificated prior to 1992, or an update qualification for alternate engine or avionics fits. A sponsor seeking to have an FSTD qualified in accordance with the QPS in this manual should submit a VDR to the MSP as early as possible in the planning stages. The MSP is the final authority to approve the data to be used as validation material in the QTG.
- 5.6.2 The VDR should identify (in matrix format) sources of data for all required objective tests. It should also provide guidance regarding the validity of these data for a specific engine type, thrust rating configuration, and the revision levels of all avionics affecting aircraft handling qualities and performance. The VDR should include rationale or explanation in test cases when; data or parameters are missing, engineering simulation data are to be used, flight test methods require explanation, or there are deviations from data requirements. Additionally, the document should refer to other appropriate sources of validation data (e.g., sound and vibration data documents).
- 5.6.3 A sample Validation Data Roadmap (VDR) is shown in Attachment 4.1 to Chapter 4. It depicts a generic roadmap matrix identifying sources of validation data for an abbreviated list of tests. A complete matrix should address all test conditions and provide actual data and data sources.

5.7 Acceptance Guidelines for Alternative Avionics (Flight-Related Computers and Controllers)

- 5.7.1 For a new aircraft type, the majority of flight validation data are collected on the first certified aircraft configuration with a “baseline” avionics ship-set. These data are then used to validate all flight simulators representing that aircraft type. Hardware design changes or software revisions to some baseline avionic systems, components or functionality may significantly alter the aircraft’s response, which in turn may significantly change the FTD performance and QTG results. Examples of such systems are; flight control computers, controllers for engines, autopilots, braking systems, nosewheel steering systems, and related avionics such as augmentation systems.
- 5.7.2 The MSP may require additional validation data for a FSTD with avionic hardware designs that differ from the baseline configuration, or if a software revision differs from a previously validated configuration. The QTG for a FSTD with additional or alternate avionics configurations should contain selected objective test cases and data to validate any significant performance differences attributed to the avionics configuration.
- 5.7.3 **Approval Guidelines for Validating Alternate Avionics.** The MSP will apply the following guidelines when qualifying FSTDs representing aircrafts with a revised avionics configuration, or more than one avionics configuration:
- a. The baseline validation data should be based on flight test data, except where other data are specifically allowed (e.g., engineering flight simulator data).
 - b. The sponsor is responsible for determining and disclosing whether validation data used in the QTG is affected by an alternative avionics fit.
 - c. Validation data from the previously validated avionics configuration may be used provided that:
 - 1) Avionics system or component changes do not affect QTG results. This includes updates to avionics systems that are tied to aircraft response but do not affect QTG results (e.g., the avionics change is a Built-In-Test-Equipment (BITE) update or a modification in a different flight phase). The QTG should include authoritative justification from the aircraft manufacturer or system supplier that this avionics change does not affect the test; or
 - 2) No new functionality is added and the impact of the avionics change on the aircraft response is demonstrated to be small based on acceptable and proven aeronautical

principles. This should be supplemented with avionics-specific validation data from the aircraft manufacturer's engineering simulation, using the revised avionics configuration. The QTG should include an explanation of the change and its effect on the aircraft response.

d. Supplemental flight test data is required to validate the alternate avionics revision if:

- 1) An avionics change significantly affects some QTG results, or
- 2) New functionality is added to the avionics system.

Note: Additional flight test validation data may not be needed if the avionics changes were certified without the need for testing with a comprehensive flight instrumentation package. The aircraft manufacturer should coordinate flight simulator data requirements in advance with the MSP.

h. The Validation Road Map in the QTG should be amended to reflect the appropriate validation data source for each test. The roadmap should identify the revision state of the avionics systems that could affect specific test responses.

5.8 Initial (and Upgrade) Qualification Requirements

5.8.1 In order to be qualified at a particular qualification level, the FTD must:

- a. Meet the general requirements at Appendix C1 for aeroplanes, or Appendix D1 for rotorcrafts;
- b. Meet the objective testing requirements at Appendix C2 for aeroplanes, or Appendix D2 for rotorcrafts; and
- c. Satisfactorily accomplish the subjective tests at Appendix C3 for aeroplanes, or Appendix D3 for rotorcrafts.

5.8.2 The application for initial evaluation described in Chapter 3, Section 3.3 of this manual must include all of the following:

- a. A statement that the FTD meets all of the applicable provisions of this part and all applicable provisions of the QPS.
- b. Unless otherwise authorized by the MSP, a letter of compliance from the sponsor to the MSP (as described in paragraph 3.3.3 of this manual) no later than 5 business days prior to the scheduled.
- c. A QTG, acceptable to the MSP, that includes all of the following where required by the QPS:
 - 1) Objective data obtained from aircraft testing or another approved source.
 - 2) Correlating objective test results obtained from the performance of the.
 - 3) The result of FTD subjective tests.
 - 4) A description of the equipment necessary to perform the evaluation for initial qualification and the continuing qualification evaluations.

5.8.3 The QTG described in paragraph [4.14.25.8.2c](#) of this section, must provide the documented proof of compliance with the simulator objective tests in Appendix C2, Table C2A for aeroplanes, or Appendix D2, Table D2A for rotorcraft.

5.8.4 The QTG is prepared and submitted by the sponsor, or the sponsor's agent on behalf of the sponsor, to the MSP for review and approval, and must include, for each objective test:

- a. Parameters, tolerances, and flight conditions.
- b. Pertinent and complete instructions for the conduct of automatic and manual tests.
- c. A means of comparing the FTD test results to the objective data.
- d. Any other information as necessary, to assist in the evaluation of the test results.

- e. Other information appropriate to the qualification level of the FTD.

5.8.5 The QTG must include the following:

- a. A QTG cover page with sponsor and TC approval signature blocks.
- b. An FTD information page that provides the information listed in this paragraph. For convertible FTDs, the sponsor must submit a separate page for each configuration of the FTD.
 - 1) The sponsor's FTD identification number or code.
 - 2) The aircraft model and series being simulated.
 - 3) The aerodynamic data revision number or reference.
 - 4) The source of the basic aerodynamic model and the aerodynamic coefficient data used to modify the basic model.
 - 5) The engine model(s) and its data revision number or reference.
 - 6) The flight control data revision number or reference.
 - 7) The flight management system identification and revision level.
 - 8) The FTD model and manufacturer.
 - 9) The date of FTD manufacture.
 - 10) The FTD computer identification.
 - 11) The visual system model and manufacturer, including display type.
 - 12) The motion system type and manufacturer, including degrees of freedom.
- c. A Table of Contents.
- d. A log of revisions and a list of effective pages.
- e. List of all relevant data references.
- f. A glossary of terms and symbols used (including sign conventions and units).
- g. Statements of compliance and capability (SOCs) with certain requirements.
- h. Recording procedures or equipment required to accomplish the objective tests.
- i. The following information for each objective test designated in Appendix C2, Table C2A (aeroplanes) Appendix D2, Table D2A (rotorcraft) as applicable to the qualification level sought:
 - 1) Name of the test.
 - 2) Objective of the test.
 - 3) Initial conditions.
 - 4) Manual test procedures.
 - 5) Automatic test procedures (if applicable).
 - 6) Method for evaluating FTD objective test results.
 - 7) List of all relevant parameters driven or constrained during the automatically conducted test(s).
 - 8) List of all relevant parameters driven or constrained during the manually conducted test(s).
 - 9) Tolerances for relevant parameters.
 - 10) Source of Validation Data (document and page number).
 - 11) Copy of the Validation Data (if located in a separate binder, a cross reference for the identification and page number for pertinent data location must be provided).
 - 12) Simulator Objective Test Results as obtained by the sponsor. Each test result must reflect the date completed and must be clearly labeled as a product of the device being tested.

- 5.8.6 The National Simulator Evaluation Program (NSEP) considers convertible FTDs as a separate FTD for each converted configuration. If a sponsor seeks qualification for two or more models of an aircraft type using a convertible FTD, the sponsor must submit a QTG for each aircraft model, or a QTG for the first aircraft model and a supplement to that QTG for each additional aircraft model. The MSP will conduct evaluations of each aircraft model.
- 5.8.7 The following describes the acceptable form and manner of presentation of objective test results in the QTG:
- The sponsor's FTD test results must be recorded in a manner acceptable to the MSP, that allows easy comparison of the FTD test results to the validation data (e.g., use of a multi-channel recorder, line printer, cross plotting, overlays, transparencies).
 - FTD results must be labeled using terminology common to aircraft parameters as opposed to computer software identifications.
 - Validation data documents included in a QTG may be photographically reduced only if such reduction will not alter the graphic scaling or cause difficulties in scale interpretation or resolution.
 - Scaling on graphical presentations must provide the resolution necessary to evaluate the parameters shown in Appendix C2, Table C2A for aeroplanes, or Appendix D2, Table D2A for rotorcrafts.
 - Tests involving time histories, data sheets (or transparencies thereof) and FTD test results must be clearly marked with appropriate reference points to ensure an accurate comparison between the FTD and the aircraft with respect to time. Time histories recorded via a line printer are to be clearly identified for cross plotting on the aircraft data. Over-plots must not obscure the reference data.
- 5.8.8 The sponsor may elect to complete the QTG objective and subjective tests at the manufacturer's facility or at the sponsor's training facility (or other sponsor designated location where training will take place). If the tests are conducted at the manufacturer's facility, the sponsor must repeat at least one-third of the tests at the sponsor's training facility in order to substantiate FTD performance. The QTG must be clearly annotated to indicate when and where each test was accomplished. Tests conducted at the manufacturer's facility and at the sponsor's training facility must be conducted after the FTD is assembled with systems and sub-systems functional and operating in an interactive manner. The test results must be submitted to the MSP.
- 5.8.9 The sponsor must maintain a copy of the MQTG at the FTD location.
- 5.8.10 During the initial (or upgrade) qualification evaluation conducted by the MSP, the sponsor must also provide a person who is a user of the device (e.g., a qualified pilot or instructor pilot with flight time experience in that aircraft) and knowledgeable about the operation of the aircraft and the operation of the FTD.

5.9 Flight Training Device Level 5, 6 and 7 - Subjective Testing

- 5.9.1 The subjective tests provide a basis for evaluating the capability of the simulator to perform over a typical utilization period; determining that the simulator accurately simulates each required maneuver, procedure, or task; and verifying correct operation of the simulator controls, instruments, and systems. The items listed in the following tables are for simulator evaluation purposes only. They may not be used to limit or exceed the authorizations for use of a given level of simulator, as described on the SOQ, or as approved by the TPAA:
- Tables A3A (Aeroplanes) and B3A (Rotorcraft) - Operations Tasks** are tests that address pilot functions, including maneuvers and procedures (called flight tasks), and are divided by flight phases. The performance of these tasks by the MSP includes an operational examination of the visual system and special effects. There are flight tasks included to address some features of advanced technology aircrafts and innovative training programs. For example, "high angle-of-attack maneuvering" is included to provide a required alternative to "approach to stalls" for aircrafts employing flight envelope protection functions.

- b. **Tables A3A (Aeroplanes) and B3A (Rotorcraft), Operations Tasks; and Tables A3G and B3G, Instructor Operating Station** are tests that address the overall function and control of the simulator including the various simulated environmental conditions; simulated aircraft system operations (normal, abnormal, and emergency); visual system displays; and special effects necessary to meet flight crew training, evaluation, or flight experience requirements.

5.9.2 All simulated aircraft systems functions will be assessed for normal and, where appropriate, alternate operations. Normal, abnormal, and emergency operations associated with a flight phase will be assessed during the evaluation of flight tasks or events within that flight phase. Simulated aircraft systems are listed separately under “Any Flight Phase” to ensure appropriate attention to systems checks. Operational navigation systems (including inertial navigation systems, global positioning systems, or other long-range systems) and the associated electronic display systems will be evaluated if installed. The NSEP evaluation report will identify any observed system operational discrepancies and any system limitation.

5.9.3 At the request of the TPAA, the MSP may assess a device to determine if it is capable of simulating certain training activities in a sponsor's training program, such as a portion of a Line Oriented Flight Training (LOFT) scenario. Unless directly related to a requirement for the qualification level, the results of such an evaluation would not affect the qualification level of the simulator. However, if the MSP determines that the simulator does not accurately simulate that training activity, the simulator would not be approved for that training activity.

5.9.4 Transport Canada intends to allow the use of Class III airport models when the sponsor provides the TPAA (or other regulatory authority) an appropriate analysis of the skills, knowledge, and proficiency objectives necessary for competent performance of the tasks using the Class III model. The analysis should describe the ability of the FTD/visual media and model to adequately support the required pilot training objective. The analysis should also include the specific media element, such as the airport model.

5.10 Flight Training Device Level 4 – Subjective Evaluation Method

5.10.1 A Level 4 FTD is one that may have an open aircraft-specific flight deck area, or an enclosed aircraft-specific flight deck and at least one operating system. The device must have air/ground logic but does not require an aerodynamic model validated against flight test data. All displays may be flat/LCD panel representations or actual representations of displays in the aircraft. All controls, switches, and knobs may be touch sensitive activation (not capable of manual manipulation of the flight controls) or may physically replicate the aircraft in control operation. Qualification of Level 4 FTDs are based on functions and subjective evaluation of the installed systems and their associated training tasks.

5.10.2 Level 4 FTDs are typically limited to procedural and system training only; however, some devices that physically replicate the aircraft in control operation and provide sophisticated avionics and aircraft system modelling, may allow training credits procedural training for certain tasks, which could potentially offset time required for the FFS. In order to provide the TPAA with the guidance necessary to determine how the device could be used in an approved training program, the subjective evaluation must define the degree and range of training that each specific design can support. The NSEP has therefore adopted a method for subjective evaluation that allows the sponsor to identify the training tasks and the level of training that they propose for the Level 4 FTD qualification. The MSP will subjectively evaluate the device to determine whether the training tasks proposed are adequately supported and recommend an appropriate level of training for each task. Final approval for any credits in an approved training program will rest solely with the TPAA.

5.10.3 When responding to the sponsor's letter of intent for evaluation (See Chapter 3), the MSP will provide a blank copy of Table C3E (aeroplanes) or Table D3E (Rotorcraft) to be completed by the sponsor prior to the evaluation.

- a. The letter “N” has been pre-populated in Table C3E and D3E to denote tasks level assignments that are not appropriate for Level 4 FTDs or require validated aerodynamic and control models, or motion / visual cueing.

- b. The sponsor may request tasks in addition to those listed in Table C3E and D3E.
 - c. The MSP will include a list of the task that have been assigned a training level on the FSTD certificate. This list will be the basis for subsequent recurrent evaluation.
- 5.10.4 The MSP will use the following criteria when assessing the level of training recommended for a particular task:
- a. **Procedural Training.** The FTD must sufficiently represent the system controls and functionality to train and rehearse procedures as per the type-specific AFM or SOP without modification or deviation.
 - b. **Skill Training.** The FTD must physically replicate all controls, knobs and switches used by the pilot to perform the task. The relative position of controls to the pilot seat position must be sufficiently representative to reinforce skill transfer to the FFS. The FTD must allow the pilot to apply procedures as per AFM or SOP without modification, deviation or instructor intervention. Avionic and aircraft system responses and behaviour must not interfere or distract from the task.
 - c. **Manoeuvre Training.** The FTD must meet the criteria for skill training for the specific task, and, the functionality and performance of the system or subsystems supporting the task must emulate the aircraft to a degree suitable for proficiency checks on the particular task. On a level 4 FTD, manoeuvre training credits are rare. They pertain only to systems or subsystems where the pilot proficiency is fully transferable to the FFS and will not require additional training in the FFS syllabus prior to a Pilot Proficiency Check (PPC).

5.11 Conduct of Initial and Upgrade Evaluations

- 5.11.1 The MSP will only evaluate those FTDs that are sponsored by a certificate holder as defined in Chapter 1 of this manual. However, the Minister may deem it appropriate to approve other FTD evaluations on a case-by-case basis provided they are conducted in accordance with applicable agreements.
- 5.11.2 The MSP will evaluate each FTD configuration as completely as possible. To ensure a thorough and uniform evaluation, each FTD will be evaluated against the general simulator requirements in Appendix C1 or D1, the objective tests listed in Appendix C2 (aeroplanes) or D2 (rotorcraft), and the subjective tests listed in Appendix C3 (aeroplanes) or D3 (rotorcraft), as applicable. The evaluations will include, but not necessarily be limited to the following:
- a. Aircraft responses, including longitudinal and lateral-directional control responses (see Appendix C2 (aeroplanes) or D2 (rotorcraft) as applicable);
 - b. Performance in authorized portions of the simulated aircraft's operating envelope, to include tasks evaluated by the MSP in the areas of surface operations, takeoff, climb, cruise, descent, approach, and landing as well as abnormal and emergency operations (see Appendix C2 (aeroplanes) or D2 (rotorcraft));
 - c. Control checks (see Appendix C1 and C2 (aeroplanes) or Appendix D1 and D2 (rotorcraft) as applicable);
 - d. Flight deck configuration (see Appendix C1 (aeroplanes) or D1 (rotorcraft) as applicable);
 - e. Pilot, flight engineer, and instructor station functions checks (see Appendix C1 and C3 (aeroplanes) or Appendix D1 and D3 (rotorcraft) as applicable);
 - f. Aircraft systems and sub-systems (as appropriate) as compared to the aircraft simulated (see Appendix C1 and C3 (aeroplanes) or Appendix D1 and D3 (rotorcraft) as applicable);
 - g. FTD systems and sub-systems, including force cueing (motion), visual, and aural (sound) systems, as appropriate (see Appendix C1 and C2 (aeroplanes) or Appendix D1 and D2 (rotorcraft) as applicable); and

- h. Certain additional requirements, depending upon the qualification level sought, including equipment or circumstances that may become hazardous to the occupants. The sponsor may be subject to Occupational Safety and Health Administration requirements.
- 5.11.3 The MSP administers the objective and subjective tests, which includes an examination of functions. The tests include a qualitative assessment of the FTD by a TC pilot. The NSEP evaluation team leader may assign other qualified personnel to assist in accomplishing the functions examination and/or the objective and subjective tests performed during an evaluation when required.
 - a. Objective tests provide a basis for measuring and evaluating FTD performance and determining compliance with the requirements of this Chapter.
 - b. Subjective tests provide a basis for:
 - 1) Evaluating the capability of the FTD to perform over a typical utilization period;
 - 2) Determining that the FTD satisfactorily simulates each required task;
 - 3) Verifying correct operation of the FTD controls, instruments, and systems; and
 - 4) Demonstrating compliance with the requirements of this manual.
- 5.11.4 The tolerances for the test parameters listed in Appendix C2 (aeroplanes) or D2 (rotorcraft) as applicable reflect the range of tolerances acceptable to the MSP for FTD validation and are not to be confused with design tolerances specified for FTD manufacture. In making decisions regarding tests and test results, the MSP relies on the use of operational and engineering judgment in the application of data (including consideration of the way in which the flight test was flown and the way the data was gathered and applied), data presentations, and the applicable tolerances for each test.
- 5.11.5 In addition to the scheduled continuing qualification evaluation, each FTD is subject to evaluations conducted by the MSP at any time without prior notification to the sponsor. Such evaluations would be accomplished in a normal manner (i.e., requiring exclusive use of the FTD for the conduct of objective and subjective tests and an examination of functions) if the FTD is not being used for pilot training and checking. However, if the FTD were being used, the evaluation would be conducted in a non-exclusive manner. The FTD evaluator will accompany the ACP, instructor, or TC inspector aboard the FTD along with the student(s) and observe the operation of the FTD during the training, testing, or checking activities in a non-interference manner.
- 5.11.6 Problems with objective test results are handled as follows:
 - a. If a problem with an objective test result is detected by the NSEP evaluation team during an evaluation, the test may be repeated or the QTG may be amended.
 - b. If it is determined that the results of an objective test do not support the level requested but do support a lower level, the MSP may qualify the FTD at that lower level. For example, if a Level 6 evaluation is requested and the FTD fails to meet sound test tolerances, it could be qualified at Level 5.
- 5.11.7 After an FTD is successfully evaluated, the MSP issues a Qualification Certificate to the sponsor. The Certificate is also the MSP's recommendation to the TPAA that the FTD may be used in a TC approved training program. The certificate will be issued at the satisfactory conclusion of the initial or continuing qualification evaluation and will list the tasks for which the FTD is qualified, referencing the tasks described in Appendix C3, Tables C3B or C3E, (aeroplanes) or Appendix D3, Table D3B (rotorcraft) as applicable. However, it is the sponsor's responsibility to ensure TPAA approval for each air operator or private operator using the FTD in a TC approved training program.

Note: For level 4 FTDs, the Qualification Certificate will include a list of the tasks from Table C3E that were subjectively evaluated and include the recommended training levels.
- 5.11.8 Under normal circumstances, the MSP will tentatively schedule a date for the initial or upgrade evaluation within fifteen (15) working days after receiving the sponsor's request (letter of intent) and confirm the evaluation date when the complete QTG is acceptable. Sponsor application procedures for initial evaluations are found in Section 3.3 of the manual.

- 5.11.9 The numbering system used for objective test results in the QTG should closely follow the numbering system set out in Appendix C2, Table C2A (aeroplanes) or Appendix D2, Table D2A (rotorcraft) as applicable.

5.12 Continuing Qualification Evaluations and Requirements

- 5.12.1 The sponsor must conduct a minimum of four evenly spaced inspections throughout the year. The objective test sequence and content of each inspection must be developed by the sponsor and must be acceptable to the MSP.
- 5.12.2 The sponsor's test sequence and the content of each quarterly inspection required in chapter 2, paragraph 2.8.1 a) of this manual should include a balance and a mix from the objective test requirement areas listed as follows:
- a. Performance.
 - b. Handling qualities.
 - c. Motion system (where appropriate).
 - d. Visual system (where appropriate).
 - e. Sound system (where appropriate).
 - f. Other FTD systems.
- 5.12.3 The description of the functional pre-flight check must be contained in the sponsor's maintenance procedures.
- 5.12.4 The sponsor must record "functional pre-flight" in the FTD discrepancy log book or other acceptable location, including any item found to be missing, malfunctioning, or inoperative.
- 5.12.5 During the continuing qualification evaluation conducted by the NSEP, the sponsor must also provide a person knowledgeable about the operation of the aircraft and the operation of the FTD.
- 5.12.6 The MSP will ensure the frequency of continuing qualification evaluations is in accordance with the requirements of section 606.03 of the Canadian Aviation Regulations (CARs) unless the MSP becomes aware of discrepancies or performance problems with the device that warrants more frequent evaluations.
- 5.12.7 If the NSEP evaluator plans to accomplish specific tests during a normal continuing qualification evaluation that requires the use of special equipment or technicians, the sponsor will be notified as far in advance of the evaluation as practical; but not less than 72 hours. Examples of such tests include latencies, control dynamics, sounds and vibrations, motion, and/or some visual system tests.
- 5.12.8 The continuing qualification evaluations, described in Chapter 3, paragraph 3.8.3 of this manual will normally require 4 hours of FTD time. However, flexibility is necessary to address abnormal situations or situations involving aircraft with additional levels of complexity (e.g., computer controlled aircraft). The sponsor should anticipate that some tests may require additional time. The continuing qualification evaluations will consist of the following:
- a. Review of the results of the quarterly inspections conducted by the sponsor since the last scheduled continuing qualification evaluation.
 - b. A random selection of objective tests from the MQTG that provide an adequate opportunity to evaluate the performance of the FTD. The tests chosen will be performed either automatically or manually and should be able to be conducted within approximately one-third of the allotted FTD time.
 - c. A subjective evaluation of the FTD to perform a representative sampling of the tasks set out in Appendix C3 (aeroplanes) or Appendix D3 (rotorcraft) as applicable. This portion of the evaluation should take approximately two-thirds of the allotted FTD time.
 - d. An examination of the functions of the FTD may include the motion system, visual system, sound system, instructor operating station, and the normal functions and simulated malfunctions

of the aeroplane systems. This examination is normally accomplished simultaneously with the subjective evaluation requirements.

Appendix C1 - Aeroplane Type-Specific Flight Training Device – General Simulator Requirements

1. This Appendix describes the general simulator requirements for qualifying an aeroplane type-specific FTD (Levels 4 to 7). The sponsor should also consult the objective tests in Appendix C2 and functions and subjective tests listed in Appendix C3 of this to determine the complete requirements for an aeroplane specific level simulator.
2. The material contained in this Appendix is divided into the following categories:
 - a. General flight deck configuration.
 - b. Simulator programming.
 - c. Equipment operation.
 - d. Equipment and facilities for instructor/evaluator functions.
 - e. Motion system.
 - f. Visual system.
 - g. Sound system.
3. Table C1A provides the standards for the General Simulator Requirements.
4. Table C1B provides the tasks that the sponsor will examine to determine whether the FTD satisfactorily meets the requirements for flight crew training, testing, and experience, and provides the tasks for which the simulator may be qualified.
5. Table C1C provides the functions that an instructor/check pilot must be able to control in the simulator.
6. It is not required that all of the tasks that appear on the List of Qualified Tasks (part of the SOQ) be accomplished during the initial or continuing qualification evaluation.

Table C1A – Aeroplane - Type-Specific Flight Training Device - Minimum Flight Training Device Requirements

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements							
QPS Requirements						INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes	
		4	5	6	7		
1. GENERAL FLIGHT DECK CONFIGURATION							
1.a.	The FTD must have a flight deck that is a replica of the airplane simulated with controls, equipment, observable flight deck indicators, circuit breakers, and bulkheads properly located, functionally accurate and replicating the airplane. The direction of movement of controls and switches must be identical to that in the airplane. Pilot seat(s) must afford the capability for the occupant to be able to achieve the design “eye position.” Equipment for the operation of the flight deck windows must be included, but the actual windows need not be operable. Fire axes, extinguishers, and spare light bulbs must be available in the flight FTD, but may be relocated to a suitable location as near as practical to the original position. Fire axes, landing gear pins, and any similar purpose instruments need only be represented in silhouette. The use of electronically displayed images with physical overlay or masking for FTD instruments and/or instrument panels is acceptable provided: (1) All instruments and instrument panel layouts are dimensionally correct with differences, if any, being imperceptible to the pilot; (2) Instruments replicate those of the airplane including full instrument functionality and embedded logic; (3) Instruments displayed are free of quantization (stepping); (4) Instrument display characteristics replicate those of the airplane including: resolution, colors, luminance, brightness, fonts, fill patterns, line styles and symbology; (5) Overlay or masking, including bezels and bugs, as applicable, replicates the airplane panel(s); (6) Instrument controls and switches replicate and operate with the same technique, effort, travel and in the same direction as those in the airplane; (7) Instrument lighting replicates that of the airplane 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; and (8) As applicable, instruments must have faceplates that replicate those in the airplane;				X	X	For FTD purposes, the flight deck consists of all that space forward of a cross section of the fuselage at the most extreme aft setting of the pilots' seats including additional, required flight crewmember duty stations and those required bulkheads aft of the pilot seats. For clarification, bulkheads containing only items such as landing gear pin storage compartments, fire axes and extinguishers, spare light bulbs, aircraft documents pouches are not considered essential and may be omitted. For Level 6 FTDs, flight deck window panes may be omitted where non-distracting and subjectively acceptable to conduct qualified training tasks.

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements

QPS Requirements						INFORMATION
Entry No.	Minimum FTD Requirements	Simulator Level				Notes
		4	5	6	7	
	Level 7 FTD 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 the principle operator's angle, should replicate that of the actual airplane instrument. Any instrument reading inaccuracy due to viewing angle and parallax present in the actual airplane instrument should be duplicated in the simulated instrument display image. Viewing angle error and parallax must be minimized on shared instruments such and engine displays and standby indicators.				X	
1.b.	The FTD must have equipment (e.g., instruments, panels, systems, circuit breakers, and controls) simulated sufficiently for the authorized training/checking events to be accomplished. The installed equipment must be located in a spatially correct location and may be in a flight deck or an open flight deck area. Additional equipment required for the authorized training/checking events must be available in the FTD, but may be located in a suitable location as near as practical to the spatially correct position. Actuation of equipment must replicate the appropriate function in the airplane. Fire axes, landing gear pins, and any similar purpose instruments need only be represented in silhouette.	X	X			
1.c	Those circuit breakers that affect procedures or result in observable flight deck indications must be properly located and functionally accurate.				X	
2. PROGRAMMING						
2.a.1	The FTD must provide the proper effect of aerodynamic changes for the combinations of drag and thrust normally encountered in flight. This must include the effect of change in airplane attitude, thrust, drag, altitude, temperature, and configuration. Level 6 additionally requires the effects of changes in gross weight and center of gravity. Level 5 requires only generic aerodynamic programming. An SOC is required.		X	X		

QPS Requirements						INFORMATION
Entry No.	Minimum FTD Requirements	Simulator Level				Notes
		4	5	6	7	
2.a.2	A flight dynamics model that accounts for various combinations of drag and thrust normally encountered in flight must correspond to actual flight conditions, including the effect of change in airplane attitude, thrust, drag, altitude, temperature, gross weight, moments of inertia, center of gravity location, and configuration. The effects of pitch attitude and of fuel slosh on the aircraft center of gravity must be simulated. An SOC is required.				X	
2.b	The FTD must have the computer capacity, accuracy, resolution, and dynamic response needed to meet the qualification level sought. An SOC is required.	X	X	X	X	
2.c.1	Relative responses of the flight deck instruments must be measured by latency tests, or transport delay tests, and may not exceed 300 milliseconds. The instruments must respond to abrupt input at the pilot's position within the allotted time, but not before the time when the airplane responds under the same conditions. (1) Latency: The FTD instrument and, if applicable, the motion system and the visual system response must not be prior to that time when the airplane responds and may respond up to 300 milliseconds after that time under the same conditions. (2) Transport Delay: As an alternative to the Latency requirement, a transport delay objective test may be used to demonstrate that the FTD system does not exceed the specified limit. The sponsor must measure all the delay encountered by a step signal migrating from the pilot's control through all the simulation software modules in the correct order, using a handshaking protocol, finally through the normal output interfaces to the instrument display and, if applicable, the motion system, and the visual system.		X	X		The intent is to verify that the FTD provides instrument cues that are, within the stated time delays, like the airplane responses. For airplane response, acceleration in the appropriate, corresponding rotational axis is preferred. Additional information regarding Latency and Transport Delay testing may be found in Chapter 4, Section 4.11.
2.c.2	Relative responses of the motion system, visual system, and flight deck instruments, measured by latency tests or transport delay tests. Motion onset should occur before the start of the visual scene change (the start of the scan of the first video field containing different information) but must occur before the end of the scan of that video field. Instrument response may not occur prior to motion onset. Test results must be within the following limits: 100 ms for the motion (if installed) and instrument systems; and 120 ms for the visual system.		X	X		The intent is to verify that the FTD provides instrument, motion, and visual cues that are, within the stated time delays, like the airplane responses. For airplane response, acceleration in the appropriate, corresponding rotational axis is preferred.
2.d.	Ground handling and aerodynamic programming must include the following:					

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements						
QPS Requirements					INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes
		4	5	6	7	
2.d.1	Ground effect.				X	Ground effect includes modeling that accounts for round-out, flare, touchdown, lift, drag, pitching moment, trim, and power while in ground effect.
2.d.2	Ground reaction.				X	Ground reaction includes modeling that accounts for strut deflections, tire friction, and side forces. This is the reaction of the aeroplane upon contact with the runway during landing, and may differ with changes in factors such as gross weight, airspeed, or rate of descent on touchdown.
2.d.3	Ground handling characteristics, including aerodynamic and ground reaction modeling including steering inputs, operations with crosswind, braking, thrust reversing, deceleration, and turning radius.				X	

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements

QPS Requirements					INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes
		4	5	6	7	
2.e.	If the aircraft being simulated is required to have a Low-altitude windshear system installed to meet TC type-certification requirements, the simulator must employ windshear models that provide training for recognition of windshear phenomena and the execution of recovery procedures. Models must be available to the instructor/evaluator for the following critical phases of flight: (1) Prior to takeoff rotation; (2) At liftoff; (3) During initial climb; and (4) On final approach, below 500 ft. AGL. The QTG must reference the FAA Windshear 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 Aerospace Establishment (RAE), the Joint Airport Weather Studies (JAWS) Project and other recognized sources may be implemented, but must be supported and properly referenced in the QTG. Only those simulators meeting these requirements may be used to satisfy the CAR training requirements pertaining to a certificate holder's approved low-altitude windshear flight training program. The addition of realistic levels of turbulence associated with each required windshear profile must be available and selectable to the instructor. In addition to the four basic windshear models required for qualification, at least two additional "complex" windshear models must be available to the instructor which represent the complexity of actual windshear encounters. These models must be available in the takeoff and landing configurations and must consist of independent variable winds in multiple simultaneous components. The Windshear Training Aid provides two such example "complex" windshear models that may be used to satisfy this requirement.				X	Windshear models may consist of independent variable winds in multiple simultaneous components. The FAA Windshear Training Aid presents one acceptable means of compliance with FTD wind model requirements. The FTD should employ a method to ensure the required survivable and non-survivable windshear scenarios are repeatable in the training environment. For Level 7 FTDs, windshear training tasks may only be qualified for aircraft equipped with a synthetic stall warning system. The qualified windshear profile(s) are evaluated to ensure the synthetic stall warning (and not the stall buffet) is first indication of the stall.
2.f.	The simulator must provide for manual and automatic testing of simulator hardware and software programming to determine compliance with simulator objective tests as prescribed in Appendix C2. An SOC is required.				X	Automatic "flagging" of out-of-tolerance situations is encouraged.

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements							
QPS Requirements						INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes	
		4	5	6	7		
2.g.	The FTD must accurately reproduce the following runway conditions: (1) Dry; (2) Wet; (3) Icy; (4) Patchy Wet; (5) Patchy Icy; and (6) Wet on Rubber Residue in Touchdown Zone. An SOC is required.				X		
2.h.	The simulator must simulate: (1) Brake and tire failure dynamics, including antiskid failure; and (2) Decreased brake efficiency due to high brake temperatures, if applicable. An SOC is required				X	FTD pitch, side loading, and directional control characteristics should be representative of the aeroplane.	

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements

QPS Requirements						INFORMATION
Entry No.	Minimum FTD Requirements	Simulator Level				Notes
		4	5	6	7	
2.i.	Engine and Airframe Icing Modeling that includes the effects of icing, where appropriate, on the airframe, aerodynamics, and the engine(s). Icing models must 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. Aircraft systems (such as the stall protection system and auto-flight system) must respond properly to ice accretion consistent with the simulated aircraft. Aircraft OEM data or other acceptable analytical methods must be utilized to develop ice accretion models. Acceptable analytical methods may include wind tunnel analysis and/or engineering analysis of the aerodynamic effects of icing on the lifting surfaces coupled with tuning and supplemental subjective assessment by a subject matter expert pilot. SOC required.				X	SOC should be provided describing the effects which provide training in the specific skills required for recognition of icing phenomena and execution of recovery. The SOC should describe the source data and any analytical methods used to develop ice accretion models including verification that these effects have been tested. 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. See Chapter 6, Appendix E for further guidance material.
2.j.	The aerodynamic modeling in the FTD must include: (1) Low-altitude level-flight ground effect; (2) Mach effect at high altitude; (3) Normal and reverse dynamic thrust effect on control surfaces; (4) Aeroelastic representations; and (5) Nonlinearities due to sideslip. An SOC is required and must include references to computations of aeroelastic representations and of nonlinearities due to sideslip.				X	See Chapter 4, Section 4.8 for further information on ground effect.

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements							
QPS Requirements						INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes	
		4	5	6	7		
2.I.	The FTD must have aerodynamic and ground reaction modeling for the effects of reverse thrust on directional control, if applicable. An SOC is required.				X		
3. EQUIPMENT OPERATION.							
3.a	All relevant instrument indications involved in the simulation of the aeroplane must automatically respond to control movement or external disturbances to the simulated aeroplane; e.g., turbulence or windshear. Numerical values must be presented in the appropriate units. For Level 7 FTDs, instrument indications must also respond to effects resulting from icing.		X	X	X		
3.b.1	Navigation equipment must be installed and operate within the tolerances applicable for the airplane. Levels 6 must also include communication equipment (inter-phone and air/ground) like that in the airplane and, if appropriate to the operation being conducted, an oxygen mask microphone system. Level 5 need have only that navigation equipment necessary to fly an instrument approach.		X	X			
3.b.2	Communications, navigation, caution, and warning equipment must be installed and operate within the tolerances applicable for the airplane. Instructor control of internal and external navigational aids. Navigation aids must be usable within range or line-of-sight without restriction, as applicable to the geographic area.				X		
3.b.3	Complete navigation database for at least 3 airports with corresponding precision and non-precision approach procedures, including navigational database updates.				X		

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements						
QPS Requirements					INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes
		4	5	6	7	
3.c.1	Installed systems must simulate the applicable airplane system operation, both on the ground and in flight. Installed systems must be operative to the extent that applicable normal, abnormal, and emergency operating procedures included in the sponsor's training programs can be accomplished.					
	Level 6 must simulate all applicable airplane flight, navigation, and systems operation.	X	X	X		
	Level 5 must have at least functional flight and navigational controls, displays, and instrumentation.					
	Level 4 must have at least one airplane system installed and functional.					
3.c.2	Simulated airplane systems must operate as the airplane systems operate under normal, abnormal, and emergency operating conditions on the ground and in flight.					Airplane system operation should be predicated on, and traceable to, the system data supplied by the airplane manufacturer, original equipment manufacturer or alternative approved data for the airplane system or component. At a minimum, alternate approved data should validate the operation of all normal, abnormal, and emergency operating procedures and training tasks the FSTD is qualified to conduct.
	Once activated, proper systems operation must result from system management by the crew member and not require any further input from the instructor's controls.				X	
3.d	The lighting environment for panels and instruments must be sufficient for the operation being conducted.	X	X	X	X	Back-lighted panels and instruments may be installed but are not required.
3.e	The FTD must provide control forces and control travel that corresponds to the airplane being simulated. Control forces must react in the same manner as in the airplane under the same flight conditions.					
	For Level 7 FTDs, control systems must replicate airplane 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 must be replicated.			X	X	

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements						
QPS Requirements					INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes
		4	5	6	7	
3.f.	The FTD must provide control forces and control travel of sufficient precision to manually fly an instrument approach.		X			
3.g.	FTD control feel dynamics must replicate the airplane. This must be determined by comparing a recording of the control feel dynamics of the FTD to airplane measurements. For initial and upgrade qualification evaluations, the control dynamic characteristics must be measured and recorded directly from the flight deck controls, and must be accomplished in takeoff, cruise, and landing flight conditions and configurations.				X	
4. INSTRUCTOR OR EVALUATOR FACILITIES.						
4. a.1	In addition to the flight crewmember stations, the FTD must have suitable seating arrangement for the instructor/ACP and TC inspector. These seats must provide adequate view of crewmember's panel(s).	X	X	X		These seats need not be a replica of an aircraft seat and may be as simple as an office chair placed in an appropriate position.
4.a.2	In addition to the flight crewmember stations, the FTD must have at least two suitable seats for the instructor/ACP and TC inspector. These seats must provide adequate vision to the pilot's panel and forward windows. All seats other than flight crew seats need not represent those found in the airplane, but must be adequately secured to the floor and equipped with similar positive restraint devices.				X	The MSP will consider alternatives to this standard for additional seats based on unique flight deck configurations.
4.b.1	The FTD must have instructor controls that permit activation of normal, abnormal, and emergency conditions as appropriate. Once activated, proper system operation must result from system management by the crew and not require input from the instructor controls.	X	X	X		
4.b.2	The FTD must have controls that enable the instructor/evaluator to control all required system variables and insert all abnormal or emergency conditions into the simulated airplane systems as described in the sponsor's FAA-approved training program; or as described in the relevant operating manual as appropriate.				X	
4.c.	The simulator must have instructor controls for all environmental effects expected to be available at the IOS; e.g., clouds, visibility, icing, precipitation, temperature, storm cells and microbursts, turbulence, and intermediate and high altitude wind speed and direction.				X	
4.d.	The simulator must provide the instructor or evaluator the ability to present ground and air hazards.				X	For example, another aeroplane crossing the active runway or converging airborne traffic.

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements

QPS Requirements								INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes			
		4	5	6	7				
5. MOTION SYSTEM.									
5.a.	The FTD may have a motion system, if desired, although it is not required. If a motion system is installed and additional training, testing, or checking credits are being sought on the basis of having a motion system, the motion system operation may not be distracting and must be coupled closely to provide integrated sensory cues. The motion system must also respond to abrupt input at the pilot's position within the allotted time, but not before the time when the airplane responds under the same conditions.		X	X	X				
5.b.	If a motion system is installed, it must be measured by latency tests or transport delay tests and may not exceed 300 milliseconds. Instrument response may not occur prior to motion onset.			X	X	The motion system standards set out in this manual, Appendix A1 for at least Level A simulators are acceptable.			
6. VISUAL SYSTEM.									
6.a.	The FTD may have a visual system, if desired, although it is not required. If a visual system is installed, it must meet the following criteria:	X	X	X					
6.a.1	The visual system must respond to abrupt input at the pilot's position. An SOC is required.		X	X					
6.a.2	The visual system must be at least a single channel, non-collimated display. An SOC is required.	X	X	X					
6.a.3	The visual system must provide at least a field-of-view of 18° vertical / 24° horizontal for the pilot flying. An SOC is required.	X	X	X					
6.a.4	The visual system must provide for a maximum parallax of 10° per pilot. An SOC is required.	X	X	X					
6.a.5	The visual scene content may not be distracting. An SOC is required.	X	X	X					
6.a.6	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. An SOC is required.	X	X	X					
6.a.7	The visual system must provide for a minimum resolution of 5 arc-minutes for both computed and displayed pixel size. An SOC is required.	X	X	X					

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements

QPS Requirements					INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes
		4	5	6	7	
6.b.	If a visual system is installed and additional training, testing, or checking credits are being sought on the basis of having a visual system, a visual system meeting the standards set out for at least a Level A FFS (see Appendix A of this part) will be required. A “direct-view,” non-collimated visual system (with the other requirements for a Level A visual system met) may be considered satisfactory for those installations where the visual system design “eye point” is appropriately adjusted for each pilot’s position such that the parallax error is at or less than 10° simultaneously for each pilot. An SOC is required.			X		Directly projected, non-collimated visual displays may prove to be unacceptable for dual pilot applications.
6.c.	The FTD must have a visual system providing an out-of-the-flight deck view.				X	
6.d.	The FTD must provide a continuous visual field-of-view of at least 176° horizontally and 36° vertically or the number of degrees necessary to meet the visual ground segment requirement, whichever is greater. The minimum horizontal field-of-view coverage must be plus and minus one-half (½) of the minimum continuous field-of-view requirement, centered on the zero degree azimuth line relative to the aircraft fuselage. An SOC is required and must explain the system geometry measurements including system linearity and field-of-view. Collimation is not required but parallax effects must be minimized (not greater than 10° for each pilot when aligned for the point midway between the left and right seat eye-points).				X	The horizontal field-of-view is traditionally described as a 180° field-of-view. However, the field-of-view is technically no less than 176°. Additional field-of-view capability may be added at the sponsor’s discretion provided the minimum fields of view are retained.
6.e.	The visual system must be free from optical discontinuities and artifacts that create non-realistic cues.				X	Non-realistic cues might include image “swimming” and image “roll-off,” that may lead a pilot to make incorrect assessments of speed, acceleration, or situational awareness.
6.f.	The FTD must have operational landing lights for night scenes. Where used, dusk (or twilight) scenes require operational landing lights.				X	
6.g.	The FTD must have instructor controls for the following: (1) Visibility in statute miles (km) and runway visual range (RVR) in ft.(m); (2) Airport selection; and (3) Airport lighting.				X	
6.h.	The FTD must provide visual system compatibility with dynamic response programming.				X	

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements

QPS Requirements					INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes
		4	5	6	7	
6.i.	The FTD must show that the segment of the ground visible from the FTD flight deck is the same as from the airplane flight deck (within established tolerances) when at the correct airspeed, in the landing configuration, at the appropriate height above the touchdown zone, and with appropriate visibility.				X	This will show the modeling accuracy of RVR, glideslope, and localizer for a given weight, configuration, and speed within the airplane's operational envelope for a normal approach and landing.
6.j.	The FTD must provide visual cues necessary to assess sink rates (provide depth perception) during takeoffs and landings, to include: (1) Surface on runways, taxiways, and ramps; and (2) Terrain features.				X	
6.k.	The FTD must provide for accurate portrayal of the visual environment relating to the FTD attitude.				X	Visual attitude vs. FTD 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.
6.l.	The FTD must provide for quick confirmation of visual system color, RVR, focus, and intensity. An SOC is required.				X	
6.m.	The FTD must be capable of producing at least 10 levels of occulting.				X	
6.n.	Night Visual Scenes. When used in training, testing, or checking activities, the FTD must provide night visual scenes with sufficient scene content to recognize the airport, the terrain, and major landmarks around the airport. The scene content must allow a pilot to successfully accomplish a visual landing. Scenes must include a definable horizon and typical terrain characteristics such as fields, roads and bodies of water and surfaces illuminated by airplane landing lights.				X	

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements

QPS Requirements					INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes
		4	5	6	7	
6.o.	Dusk (or Twilight) Visual Scenes. When used in training, testing, or checking activities, the FTD must provide dusk (or twilight) visual scenes with sufficient scene content to recognize the airport, the terrain, and major landmarks around the airport. The scene content must allow a pilot to successfully accomplish a visual landing. Dusk (or twilight) scenes, as a minimum, must provide full color presentations of reduced ambient intensity, sufficient surfaces with appropriate textural cues that include self-illuminated objects such as road networks, ramp lighting and airport signage, to conduct a visual approach, landing and airport movement (taxi). Scenes must include a definable horizon and typical terrain characteristics such as fields, roads and bodies of water and surfaces illuminated by airplane landing lights. If provided, directional horizon lighting must have correct orientation and be consistent with surface shading effects. Total night or dusk (twilight) scene content must be comparable in detail to that produced by 10,000 visible textured surfaces and 15,000 visible lights with sufficient system capacity to display 16 simultaneously moving objects. An SOC is required.				X	
6.p.	Daylight Visual Scenes. The FTD must provide daylight visual scenes with sufficient scene content to recognize the airport, the terrain, and major landmarks around the airport. The scene content must allow a pilot to successfully accomplish a visual landing. Any ambient lighting must not “washout” the displayed visual scene. Total daylight scene content must be comparable in detail to that produced by 10,000 visible textured surfaces and 6,000 visible lights with sufficient system capacity to display 16 simultaneously moving objects. The visual display must be free of apparent and distracting quantization and other distracting visual effects while the FTD is in motion. An SOC is required.				X	
6.q.	The FTD must provide operational visual scenes that portray physical relationships known to cause landing illusions to pilots.				X	For example: short runways, landing approaches over water, uphill or downhill runways, rising terrain on the approach path, unique topographic features.
6.r.	The FTD must provide special weather representations of light, medium, and heavy precipitation near a thunderstorm on takeoff and during approach and landing. Representations need only be presented at and below an altitude of 2,000 ft. (610 m) above the airport surface and within 10 miles (16 km) of the airport.				X	
6.s.	The FTD must present visual scenes of wet and snow-covered runways, including runway lighting reflections for wet conditions, partially obscured lights for snow conditions, or suitable alternative effects.				X	

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements						
QPS Requirements					INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes
		4	5	6	7	
6.t.	The FTD must present realistic color and directionality of all airport lighting.				X	
6.u.	The following weather effects as observed on the visual system must be simulated and respective instructor controls provided. (1) Multiple cloud layers with adjustable bases, tops, sky coverage and scud effect; (2) Storm cells activation and/or deactivation; (3) Visibility and runway visual range (RVR), including fog and patchy fog effect; (4) Effects on own-ship external lighting; (5) Effects on airport lighting (including variable intensity and fog effects); (6) Surface contaminants (including wind blowing effect); (7) Variable precipitation effects (rain, hail, snow); (8) In-cloud airspeed effect; and (9) Gradual visibility changes entering and breaking out of cloud.				X	Scud effects are low, detached, and irregular clouds below a defined
6.v.	The FTD must 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,				X	Visual effects for light poles and raised edge lights are for the purpose of providing additional depth perception during takeoff, landing, and taxi training tasks. Three dimensional modeling of the actual poles and stanchions is not required.
7. SOUND SYSTEM						
7.a.	The FTD must provide flight deck sounds that result from pilot actions that correspond to those that occur in the aeroplane.			X	X	
7.b.	The volume control must have an indication of sound level setting which meets all qualification requirements.				X	This indication is of the sound level setting as evaluated during the FTD's initial evaluation.
7.c.	The FTD must accurately simulate the sound of precipitation, windshield wipers, and other significant aeroplane noises perceptible to the pilot during normal and abnormal operations, and include the sound of a crash (when the simulator is landed in an unusual attitude or in excess of the structural gear limitations); normal engine and thrust reversal sounds; and the sounds of flap, gear, and spoiler extension and retraction. Sounds must be directionally representative. A SOC is required.				X	

Table C1A – Aeroplane Type-Specific FTD- Minimum Simulator Requirements						
QPS Requirements					INFORMATION	
Entry No.	Minimum FTD Requirements	Simulator Level				Notes
		4	5	6	7	
7.d.	The FTD must provide realistic amplitude and frequency of flight deck noises and sounds. FTD performance must be recorded, subjectively assessed for the initial evaluation, and be made a part of the QTG.				X	

Table C1B - Aeroplane Type-Specific FTD - Tasks vs. FTD Level – Subjective Requirements

“(a)” - indicates that the system, task, or procedure, although not required to be present, may be examined if the appropriate airplane system is simulated in the FTD and is working properly.

Note: (a)* - For Level 4 FTDs, see Appendix C3 for subjective evaluation method.

“(t)” - indicates that the task may only be qualified for introductory initial or recurrent qualification training. These tasks may not be qualified for proficiency checking credits in a TC approved flight training program.

Note: Items not installed or not functional on the FTD and not appearing on the Qualification Certificate Configuration List, are not required to be listed as exceptions on the Qualification Certificate.

Table C1B - Aeroplane Type-Specific FTD - Subjective Requirements						
Entry #	Tasks vs. FTD Level	Simulator Levels				Notes
		4	5	6	7	
	In order to be qualified at the FTD qualification level indicated by the (X) , the simulator must be able to perform at least the tasks indicated herein.					
1. PREFLIGHT PROCEDURES.						
1.a.	Preflight Inspection (flight deck only)	(a)*	(a)	X	X	
1.b.	Engine Start	(a)*	(a)	X	X	
1.c.	Taxiing				(t)	
1.d.	Pre-takeoff Checks	(a)*	(a)			
2. TAKEOFF AND DEPARTURE PHASE.						
2.a.	Normal and Crosswind Takeoff				(t)	
2.b.	Instrument Takeoff				(t)	
2.c.	Engine Failure During Takeoff				(t)	
2.d.	Rejected Takeoff			(a)	X	
2.e.	Departure Procedure		X	X	X	
3. INFLIGHT MANEUVERS.						
3.a.	Steep Turns		X	X	X	
3.b.	Approaches to Stall		(a)	X	X	
3.c.	Engine Failure—Multiengine Aeroplane		(a)	X	X	
3.d.	Engine Failure—Single-Engine Aeroplane		(a)	X	X	
3.e.	Specific Flight Characteristics incorporated into the user's TC approved flight training program.	(a)*	(a)	(a)	(a)	
3.f.	Windshear Recovery				(t)	

Table C1B - Aeroplane Type-Specific FTD - Subjective Requirements						
Entry #	Tasks vs. FTD Level	Simulator Levels				Notes
		4	5	6	7	
4. INSTRUMENT PROCEDURES						
4.a.	Standard Terminal Arrival / Flight Management System Arrivals Procedures		(a)	X	X	
4.b.	Holding		(a)	X	X	
4.c.1	Precision Instrument - All engines operating.		(a)	X	X	e.g., Autopilot, Manual (Flt. Dir. Assisted), Manual (Raw Data)
4.c.2	Precision Instrument - One engine inoperative.				(t)	e.g., Manual (Flt. Dir. Assisted), Manual (Raw Data)
4.d.	Non-precision Instrument Approach.		(a)	X	X	e.g., NDB, VOR, VOR/DME, VOR/TAC, RNAV, LOC, LOC/BC, ADF, and SDF.
4.e.	Circling Approach (requires visual system)			(a)	X	Specific authorization required.
4.f.	Missed Approach :					
4.f.1	Normal.		(a)	X	X	
4.f.2	One engine Inoperative.				(t)	
5. LANDINGS AND APPROACHES TO LANDINGS.						
5.a.	Normal and Crosswind Approaches and Landings				(t)	
5.b.	Landing From a Precision / Non-Precision Approach				(t)	
5.c.	Approach and Landing with (Simulated) Engine Failure – Multiengine Aeroplane				(t)	
5.d.	Landing From Circling Approach				(t)	
5.e.	Rejected Landing				(t)	
5.f.	Landing From a No Flap or a Nonstandard Flap Configuration Approach				(t)	
6. NORMAL AND ABNORMAL PROCEDURES.						
6.a.	Engine (including shutdown and restart)	(a)*	(a)	X	X	
6.a.	Fuel System	(a)*	(a)	X	X	
6.c.	Electrical System	(a)*	(a)	X	X	
6.d.	Hydraulic System	(a)*	(a)	X	X	
6.e.	Environmental and Pressurization Systems	(a)*	(a)	X	X	
6.f.	Fire Detection and Extinguisher Systems	(a)*	(a)	X	X	
6.g.	Navigation and Avionics Systems	(a)*	(a)	X	X	
6.h.	Automatic Flight Control System, Electronic Flight Instrument System, and Related Subsystems	(a)*	(a)	X	X	

Table C1B - Aeroplane Type-Specific FTD - Subjective Requirements

Entry #	Tasks vs. FTD Level	Simulator Levels				Notes
		4	5	6	7	
6.i.	Flight Control Systems	(a)*	(a)	X	X	
6.j.	Anti-ice and Deice Systems	(a)*	(a)	X	X	
6.k.	Aircraft and Personal Emergency Equipment	(a)*	(a)	X	X	
7. EMERGENCY PROCEDURES.						
7.a.	Emergency Descent (Max. Rate)		(a)	X	X	
7.b.	Inflight Fire and Smoke Removal		(a)	X	X	
7.c.	Rapid Decompression		(a)	X	X	
7.d.	Emergency Evacuation	(a)*	(a)	X	X	
8. POST-FLIGHT PROCEDURES.						
8.a.	After-Landing Procedures	(a)*	(a)	X	X	
8.b.	Parking and Securing	(a)*	(a)	X	X	
9. INSTRUCTOR OPERATING STATION (IOS) FUNCTIONS, AS APPROPRIATE.						
9.a.	Power switch (es).	X	X	X	X	
9.b.	Aeroplane conditions	(a)*	X	X	X	e.g., GW, CG, Fuel loading and Systems.
9.c.	Airports / Runway.	X	X	X	X	e.g., Selection, Surface, Pre-sets, Lighting controls.
9.d.	Environmental controls	X	X	X	X	e.g., Clouds, Visibility, RVR, Temp, Wind, Ice, Snow, Rain, and Windshear. Appropriate defaults for nominal flight conditions on system boot up.
9.e.	Aeroplane system malfunctions (insertion / deletion)	(a)*	X	X	X	
9.f.	Locks, Freezes, and Repositioning	X	X	X	X	
9.g.	Sound Controls - On / Off / adjustment	X	X	X	X	
9.h.	Motion / Control Loading System, as appropriate. On / off / emergency stop	(a)*	(a)	(a)	(a)	
10. OBSERVER SEATS / STATIONS						
10.a.	Position / Adjustment / Position restraint system.	X	X	X	X	

Appendix C2 - Aeroplane Type-Specific Flight Training Device – Objective Tests

Introduction

4. For the purposes of this appendix, the flight conditions specified in the Flight Conditions Column of Table C2A are defined as follows:
 - i. Ground—on ground, independent of aeroplane configuration;
 - j. Take-off—gear down with flaps/slats in any certified takeoff position;
 - k. First segment climb—gear down with flaps/slats in any certified takeoff position (normally not above 50 ft. AGL);
 - l. Second segment climb—gear up with flaps/slats in any certified takeoff position (normally between 50 ft. and 400 ft. AGL);
 - m. Clean—flaps/slats retracted and gear up;
 - n. Cruise—clean configuration at cruise altitude and airspeed;
 - o. Approach—gear up or down with flaps/slats at any normal approach position as recommended by the aeroplane manufacturer; and
 - p. Landing—gear down with flaps/slats in any certified landing position.
5. The format for numbering the objective tests must match those in Table A2A. When a test number (or series of numbers) is not required, the term “Reserved” is used in the table at that location.
6. If relevant winds are present in the objective data, the wind vector should be clearly noted as part of the data presentation, expressed in conventional terminology, and related to the runway being used for the test.

Table C2A – Aeroplane Type-Specific Flight Training Device Objective Tests

Table C2A – Aeroplane Type-Specific FTD - Objective Tests									
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes	
Entry #	Title				5	6	7		
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.			X		
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.			X		
1.b.	Takeoff Note. — For Level 7 FTD, all airplane manufacturer commonly-used certificated take-off flap settings must 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).								

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
1.b.1	Ground acceleration time and distance.	±1.5 s or ±5% of time; and ±61 m (200 ft) or ±5% of distance. Level 6 FTD: ±1.5 s or ±5% of time.	Takeoff	Acceleration time and distance must be recorded for a minimum of 80% of the total time from brake release to Vr. Preliminary aircraft certification data may be used.		X	X	May be combined with normal takeoff (1.b.4.) or rejected takeoff (1.b.7.). Plotted data should be shown using appropriate scales for each portion of the maneuver. For Level 6 FTD, this test is required only if RTO training credit is sought. (Visual system required)
1.b.2	Minimum control speed, ground (Vmcg) 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.	Takeoff	Engine failure speed must be within ±1 kt of aeroplane engine failure speed. Engine thrust decay must be that resulting from the mathematical model for the engine applicable to the FSTD under test. If the modeled 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.			X	If a Vmcg test is not available, an acceptable alternative is a flight test snap engine deceleration to idle at a speed between V1 and V1-10 kt, followed by control of heading using aerodynamic control only and recovery should be achieved with the main gear on the ground. To ensure only aerodynamic control, nosewheel steering should be disabled (i.e. castored) or the nosewheel held slightly off the ground.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
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.	Takeoff	Record time history data from 10 knots before start of rotation until at least 5 seconds after the occurrence of main gear lift-off.			X	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 takeoff run through main gear lift-off or an early rotation takeoff. If either of these alternative solutions is selected, aft body contact/tail strike protection functionality, if present on the aeroplane, should be active.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
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.	Takeoff	Data required for near maximum certificated takeoff weight at mid center of gravity location and light takeoff weight at an aft center of gravity location. If the aeroplane has more than one certificated takeoff configuration, a different configuration must be used for each weight. Record takeoff profile from brake release to at least 61 m (200 ft.) AGL.			X	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 maneuver.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
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° side-slip 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; and ±2.2 daN (5 lbf) or ±10% of rudder pedal force.	Takeoff	Record takeoff profile to at least 61 m (200 ft) AGL. Engine failure speed must be within ±3 kt of aeroplane data. Test at near maximum takeoff weight.			x	

1.b.6	Crosswind takeoff.	± 3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±6 m (20 ft) height. ±2° roll angle. ±2° side-slip 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; and ±2.2 daN (5 lbf) or ±10% of rudder pedal force.	Takeoff	Record takeoff 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 must be provided as headwind and crosswind values with respect to the runway.			X	In those situations where a maximum crosswind or a maximum demonstrated crosswind is not known, contact the MSP.
1.b.7	Rejected Takeoff.	±5% of time or ±1.5 s.	Takeoff	Record at mass near maximum takeoff weight.		X	X	Autobrakes will be used where applicable.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
		$\pm 7.5\%$ of distance or ± 76 m (250 ft). For Level 6 FTD: $\pm 5\%$ of time or ± 1.5 s.		Speed for reject must be at least 80% of V1. 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 must be recorded from brake release to a full stop.				For Level 6 FTD, this test is required only if RTO training credit is sought. (Visual system required)
1.b.8	Dynamic Engine Failure After Takeoff.	$\pm 2^\circ/\text{s}$ or $\pm 20\%$ of body angular rates.	Takeoff	Engine failure speed must 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. CCA: Test in Normal and Non-normal control state.			X	For safety considerations, aeroplane flight test may be performed out of ground effect at a safe altitude, but with correct aeroplane configuration and airspeed.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
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	Flight test data are preferred; however, aeroplane performance manual data are an acceptable alternative. Record at nominal climb speed and mid initial climb altitude. FTD performance is to be recorded over an interval of at least 300 m (1 000 ft).	X	X	X	For Level 5 and Level 6 FTDs, this may be a snapshot test result.
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.	Flight test data is preferred; however, aeroplane performance manual data is 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.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
1.c.3	One Engine Inoperative Enroute Climb.	±10% time, ±10% distance, ±10% 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.			X	
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.	Approach	Flight test data or aeroplane performance manual data may be used. FSTD performance to be recorded over an interval of at least 300 m (1,000 ft). Test near maximum certificated landing weight as may be applicable to an approach in icing conditions.			X	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							
1.d.1	Level flight acceleration	±5% 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.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
1.d.2	Level flight deceleration.	±5% 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.			X	
1.d.3	Cruise performance.	±.05 EPR or ±3% N1 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.			X	
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).			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
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.	FSTD performance to be recorded over an interval of at least 900 m (3,000 ft).			X	Stabilized descent to be conducted with speed brakes extended if applicable, at mid altitude and near V _{mo} or according to emergency descent procedure.
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 must be recorded for at least 80% of the total time from touchdown to a full stop. Position of ground spoilers and brake system pressure must be plotted (if applicable). Data required for medium and near maximum certificated landing mass. Engineering data may be used for the medium mass condition.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
1.e.2	Deceleration time and distance, reverse thrust, no wheel brakes, dry runway.	± 1.5 s or $\pm 5\%$ of time; and The smaller of ± 61 m (200 ft) or $\pm 10\%$ of distance.	Landing	Time and distance must 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 must be plotted (if applicable). Data required for medium and near maximum certificated landing mass. Engineering data may be used for the medium mass condition.			X	
1.e.3	Stopping distance, wheel brakes, wet runway.	± 61 m (200 ft) or $\pm 10\%$ of distance.	Landing	Either flight test or manufacturer's performance manual data must 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.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
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 must 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.			X	
1.f.	Engines							
1.f.1	Acceleration	For Level 7: ±10% Ti or ±0.25 s; and ±10% Tt or ±0.25 s. For Level 6 FTD: ±10% Tt or ±0.25 s. For Level 5 FTD: ±1 s	Approach or landing	Total response is the incremental change in the critical engine parameter from idle power to go-around power.	X	X	X	See Chapter 1 of this manual for definitions of Ti, and Tt.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
1.f.2	Deceleration	For Level 7: $\pm 10\%$ Ti or ± 0.25 s; and $\pm 10\%$ Tt or ± 0.25 s. For Level 6 FTD: $\pm 10\%$ Tt or ± 0.25 s. For Level 5 FTD: ± 1 s	Ground	Total response is the incremental change in the critical engine parameter from idle power to go-around power.	X	X	X	See Chapter 1 of this manual for definitions of Ti, and Tt.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	

2. HANDLING QUALITIES

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.a.	Static Control Tests							
	Note.1 — Testing of position versus force is not applicable if forces are generated solely by use of aeroplane hardware in the FTD. 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 FTD. 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 — (Level 7 FTD only) FTD static control testing from the second set of pilot controls is only required if both sets of controls are not mechanically interconnected on the FTD. 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 FTD, a single set of tests is sufficient.							
2.a.1.a	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	Record results for an uninterrupted control sweep to the stops.		X	X	Test results should be validated with in-flight data from tests such as longitudinal static stability, stalls, etc.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.a.1.b	Pitch controller position versus force	±0.9 daN (2 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force.	As determined by sponsor	Record results during initial qualification evaluation for an uninterrupted control sweep to the stops. The recorded tolerances apply to subsequent comparisons on continuing qualification evaluations.	X			Applicable only on continuing qualification evaluations. The intent is to design the control feel for Level 5 to be able to manually fly an instrument approach; and not to compare results to flight test or other such data.
2.a.2.a	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	Record results for an uninterrupted control sweep to the stops.		X	X	Test results should be validated with in-flight data from tests such as engine-out trims, steady state side-slips, etc.
2.a.2.b	Roll controller position versus force	±0.9 daN (2 lbf) breakout. ±1.3 daN (3 lbf) or ±10% of force.	As determined by sponsor	Record results during initial qualification evaluation for an uninterrupted control sweep to the stops. The recorded tolerances apply to subsequent comparisons on continuing qualification evaluations.	X			Applicable only on continuing qualification evaluations. The intent is to design the control feel for Level 5 to be able to manually fly an instrument approach; and not to compare results to flight test or other such data.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.a.3.a	Rudder pedal position versus force and surface position calibration.	±0.9 daN (2 lbf) breakout. ±1.3 daN (3 lbf) or ±10% of force. ±2° NWA.	Ground	Record results for an uninterrupted control sweep to the stops.		X	X	Test results should be validated with in-flight data from tests such as engine-out trims, steady state side-slips, etc.
2.a.3.b	Rudder pedal position versus force	±2.2 daN (5 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force.	As determined by sponsor	Record results during initial qualification evaluation for an uninterrupted control sweep to the stops. The recorded tolerances apply to subsequent comparisons on continuing qualification evaluations.	X			Applicable only on continuing qualification evaluations. The intent is to design the control feel for Level 5 to be able to manually fly an instrument approach; and not to compare results to flight test or other such data.
2.a.4.a	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	Record results for an uninterrupted control sweep to the stops.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.a.4.b	Nosewheel Steering Controller Force.	±0.9 daN (2 lbf) breakout. ±1.3 daN (3 lbf) or ±10% of force.	Ground	Record results for an uninterrupted control sweep to the stops.		X		
2.a.5	Rudder Pedal Steering Calibration.	±2° NWA.	Ground	Record results for an uninterrupted control sweep to the stops.		X	X	
2.a.6	Pitch Trim Indicator vs. Surface Position Calibration.	±0.5° trim angle.	Ground			X	X	The purpose of the test is to compare FTD surface position and indicator against the flight control model computed value.
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 must be used.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.a.8	Alignment of cockpit throttle lever versus selected engine parameter.	When matching engine parameters: ±5° of TLA. When matching detents: ±3% N1 or ±0.3 EPR or ±3% torque, or equivalent. Where the levers do not have angular travel, a tolerance of ±2 cm (±0.8 in) applies.	Ground	Simultaneous recording for all engines. The tolerances apply against aeroplane data. 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.		X	X	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.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	

2.a.9.a	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	Relate the hydraulic system pressure to pedal position in a ground static test. Both left and right pedals must be checked.			X	FTD computer output results may be used to show compliance.
2.a.9.b	Brake pedal position versus force.	±2.2 daN (5 lbf) or ±10% of force.	Ground	Two data points are required: zero and maximum deflection. Computer output results may be used to show compliance.			X	FTD computer output results may be used to show compliance. Test not required unless RTO credit is sought. (Visual required)

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.b.	Dynamic Control Tests							
	Note. — Tests 2.b.1, 2.b.2 and 2.b.3 are not applicable for FTDs 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 Chapter 4, Section 4.7.							
2.b.1	Pitch Control.	For underdamped systems: T(P0) ±10% of P0 or ±0.05 s. T(P1) ±20% of P1 or ±0.05 s. T(P2) ±30% of P2 or ±0.05 s. T(Pn) ±10*(n+1)% of Pn or ±0.05 s. T(An) ±10% of Amax, where Amax is the largest amplitude or ±0.5% of the total control travel (stop to stop). T(Ad) ±5% of Ad = residual band or ±0.5% of the maximum control travel = residual band.	Takeoff, Cruise, and Landing.	Data must 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 maneuvering load envelope). Tolerances apply against the absolute values of each period (considered independently).			X	n = the sequential period of a full oscillation. Refer to Section 4.7 of this Chapter. For over-damped and critically damped systems, see Figure 4-2 of in Section 4.7 of this Chapter for an illustration of the reference measurement.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
		±1 significant overshoots (minimum of 1 significant overshoot). Steady state position within residual band. Note 1. — <i>Tolerances should not be applied on period or amplitude after the last significant overshoot.</i> Note 2. — <i>Oscillations within the residual band are not considered significant and are not subject to tolerances.</i> For over damped and critically damped systems only: T(P0) ±10% of P0 or ±0.05 s.						

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.b.2	Roll Control.	Same as 2.b.1.	Takeoff, Cruise, and Landing.	Data must 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 maneuvering load envelope).			X	Refer to Section 4.7 of this Chapter. For over-damped and critically damped systems, see Figure 4-2 of in Section 4.7 of Chapter 4 for an illustration of the reference measurement.
2.b.3	Yaw Control.	Same as 2.b.1.	Takeoff, Cruise, and Landing.	Data must be for normal control displacement (approximately 25% to 50% of full throw).			X	Refer to Section 4.7 of this Chapter. For over-damped and critically damped systems, see Figure 4-2 of in Section 4.7 of Chapter 4 for an illustration of the reference measurement.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.b.4	Small Control Inputs – Pitch.	$\pm 0.15^\circ/\text{s}$ body pitch rate or $\pm 20\%$ of peak body pitch rate applied throughout the time history.	Approach or Landing.	Control inputs must 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 must be a minimum of 5 s before control reversal to the opposite direction. CCA: Test in normal and non-normal control state.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.b.5	Small Control Inputs – Roll.	$\pm 0.15^\circ/\text{s}$ body roll rate or $\pm 20\%$ of peak body roll rate applied throughout the time history.	Approach or Landing.	Control inputs must be typical of minor corrections made while established on an ILS approach (approximately 0.5 to $2^\circ/\text{s}$ roll rate). Test in one direction. For aeroplanes that exhibit non-symmetrical behavior, 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 must be a minimum of 5 s before control reversal to the opposite direction. CCA: Test in normal and non-normal control state.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.b.6	Small Control Inputs – Yaw.	$\pm 0.15^\circ/\text{s}$ body yaw rate or $\pm 20\%$ of peak body yaw rate applied throughout the time history.	Approach or Landing.	Control inputs must be typical of minor corrections made while established on an ILS approach (approximately 0.5 to $2^\circ/\text{s}$ 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 must be a minimum of 5 s before control reversal to the opposite direction. CCA: Test in normal and non-normal control state.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.C.	Longitudinal Control Tests <i>Note: Power setting is that required for level flight unless otherwise specified.</i>							
2.C.1.a	Power Change Dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Approach	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			X	
2.C.1.b	Power Change Force.	±5 lb (2.2 daN) or, ±20% pitch control force.	Approach	May be a series of snapshot test results. Power change dynamics test as described in test 2.c.1.a. will be accepted. CCA: Test in normal and non-normal control mode	X	X		

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.C.2.a	Flap/Slat Change Dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Takeoff through initial flap retraction, and approach to landing.	Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the reconfiguration change to the completion of the reconfiguration change + 15 s. CCA: Test in normal and non-normal control mode			X	
2.C.2.b	Flap/Slat Change Force.	±5 lb (2.2 daN) or, ±20% pitch control force.	Takeoff through initial flap retraction, and approach to landing.	May be a series of snapshot test results. Flap/Slat change dynamics test as described in test 2.c.2.a will be accepted. CCA: Test in normal and non-normal control mode	X	X		
2.C.3	Spoiler/Speedbrake Change Dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Cruise.	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			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.C.4.a	Gear Change Dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude. ±1.5° or ±20% of pitch angle.	Takeoff (retraction), and Approach (extension).	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			X	
2.C.4.b	Gear Change Force.	±5 lb (2.2 daN) or, ±20% pitch control force.	Takeoff (retraction), and Approach (extension).	May be a series of snapshot test results. Gear change dynamics test as described in test 2.c.4.a will be accepted. CCA: Test in normal and non-normal control mode	X	X		

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.C.5	Longitudinal Trim.	±1° elevator angle. ±0.5° stabilizer or trim surface 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. Level 5 FTD may use equivalent stick and trim controllers in lieu of elevator and trim surface. CCA: Test in normal or non-normal control mode, as applicable.	X	X	X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.C.6	Longitudinal Maneuvering Stability (Stick Force/g).	± 2.2 daN (5 lbf) or $\pm 10\%$ of pitch controller force. Alternative method: $\pm 1^\circ$ or $\pm 10\%$ of the change of elevator angle.	Cruise, Approach, and Landing.	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 FTD. Alternative method applies to aeroplanes which do not exhibit stick-force-per-g characteristics. CCA: Test in normal or non-normal control mode		X	X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.C.7	Longitudinal Static Stability.	± 2.2 daN (5 lbf) or $\pm 10\%$ of pitch controller force. Alternative method: $\pm 1^\circ$ or $\pm 10\%$ of the change of elevator angle.	Approach	Data for at least two speeds above and two speeds below trim speed. The speed range must 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 FTD. Alternative method applies to aeroplanes which do not exhibit speed stability characteristics. CCA: Test in normal or non-normal control mode, as applicable.	X	X	X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.C.8.a	Approach to Stall Characteristics	±3 kt airspeed for initial buffet, stall warning, and stall speeds.	Second Segment Climb, High Altitude Cruise (Near Performance Limited Condition), And Approach or Landing	Each of the following stall entries must be demonstrated in at least one of the three flight conditions: - Stall entry at wings level (1g) - Stall entry in turning flight of at least 25° bank angle (accelerated stall) - Stall entry in a power-on condition (required only for turboprop aircraft)			X	Tests may be conducted at centers of gravity typically required for airplane certification stall testing.
		Control inputs must be plotted and demonstrate correct trend and magnitude. ±2.0° pitch angle ±2.0° angle of attack ±2.0° bank angle ±2.0° sideslip angle Additionally, for those simulators with reversible flight control systems: ±10% or ±5 lb (2.2 daN)) Stick/Column force (prior to “g break” only).		The cruise flight condition must be conducted in a flaps-up (clean) configuration. The second segment climb flight condition must use a different flap setting than the approach or landing flight condition. For airplanes that exhibit stall buffet as the first indication of a stall, for qualification of this task, the FTD must be equipped with a vibration system that meets the applicable subjective and objective requirements in Appendix C of this manual.				

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.C.8.b	Stall Warning (actuation of stall warning device.)	± 3 kts airspeed, $\pm 2^\circ$ bank for speeds greater than actuation of stall warning device or initial buffet.	Second Segment Climb, and Approach or Landing.	The stall maneuver must be entered with thrust at or near idle power and wings level (1g). Record the stall warning signal and initial buffet if applicable. CCA: Test in Normal and Non-normal control states.	X	X		
2.C.9.a	Phugoid Dynamics.	$\pm 10\%$ of period. $\pm 10\%$ of time to one half or double amplitude or ± 0.02 of damping ratio.	Cruise	Test must 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.		X	X	
2.C.9.b	Phugoid Dynamics.	$\pm 10\%$ period, Representative damping.	Cruise	The test must include whichever is less of the following: Three full cycles (six overshoots after the input is completed), or the number of cycles sufficient to determine representative damping. CCA: Test in non-normal control mode.	X			

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.C.10	Short Period Dynamics.	±1.5° pitch angle or ±2°/s pitch rate. ±0.1 g normal acceleration	Cruise	CCA: (Level 7 FTD) Test in normal and non-normal control mode. (Level 6 FTD) Test in non-normal control mode.		X	X	
2.d.	Lateral Directional Tests. <i>Note: Power setting is that required for level flight unless Otherwise specified.</i>							
2.d.1	Minimum control speed, air (Vmca) or landing (Vmcl), per applicable airworthiness requirement or low speed engine-inoperative handling characteristics in the air.	±3 kt airspeed.	Takeoff or Landing (whichever is most critical in the aeroplane).	Takeoff thrust must be set on the operating engine(s). Time history or snapshot data may be used. CCA: Test in normal or non-normal control state, as applicable.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.d.2	Roll Response (Rate).	$\pm 2^\circ/\text{s}$ or $\pm 10\%$ of roll rate. For aeroplanes with reversible flight control systems (Level 7 FTD only): $\pm 1.3 \text{ daN}$ (3 lbf) or $\pm 10\%$ of wheel force.	Cruise, and Approach or Landing.	Test with normal roll control displacement (approximately one-third of maximum roll controller travel). This test may be combined with step input of flight deck roll controller test 2.d.3.	X	X	X	
2.d.3	Step input of flight deck roll controller.	$\pm 2^\circ$ or $\pm 10\%$ of roll angle.	Approach or Landing.	This test may be combined with roll response (rate) test 2.d.2. CCA: (Level 7 FTD) Test in normal and non-normal control mode. (Level 6 FTD) Test in non-normal control mode.		X	X	With wings level, apply a step roll control input using approximately one-third of the roll controller travel. When reaching approximately 20° to 30° of bank, abruptly return the roll controller to neutral and allow approximately 10 seconds of aeroplane free response.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.d.4.a	Spiral Stability.	Correct trend and $\pm 2^\circ$ or $\pm 10\%$ of roll angle in 20 s. If alternate test is used: correct trend and $\pm 2^\circ$ 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.			X	
2.d.4.b	Spiral Stability.	Correct trend and $\pm 2^\circ$ or $\pm 10\%$ of roll angle in 20 s.	Cruise	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.		X		

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.d.4.c	Spiral Stability.	Correct trend	Cruise	Aeroplane data averaged from multiple tests may be used. CCA: Test in non-normal control mode.	X			
2.d.5	Engine Inoperative Trim.	$\pm 1^\circ$ rudder angle or $\pm 1^\circ$ tab angle or equivalent rudder pedal. $\pm 2^\circ$ side-slip angle.	Second Segment Climb, and Approach or Landing.	This test may consist of snapshot tests.			X	Test should be performed in a manner similar to that for which a pilot is trained to trim an engine failure condition. 2nd segment climb test should be at takeoff thrust. Approach or landing test should be at thrust for level flight.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.d.6.a	Rudder Response.	$\pm 2^\circ/\text{s}$ or $\pm 10\%$ of yaw rate.	Approach or Landing.	For Level 7 FTD: Test with stability augmentation on and off. Test with a step input at approximately 25% of full rudder pedal throw. Not required if rudder input and response is shown in Dutch Roll test (test 2.d.7). CCA: Test in normal and non-normal control mode		X	X	
2.d.6.b	Rudder Response.	Roll rate $\pm 2^\circ/\text{sec}$, bank angle $\pm 3^\circ$.	Approach or Landing.	May be roll response to a given rudder deflection. CCA: Test in Normal and Non-normal control states.	X			May be accomplished as a yaw response test, in which case the procedures and requirements of test 2.d.6.a will apply.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.d.7	Dutch Roll	± 0.5 s or $\pm 10\%$ of period. $\pm 10\%$ of time to one half or double amplitude or ± 0.02 of damping ratio. ± 1 s or $\pm 20\%$ of time difference between peaks of roll angle and side-slip angle.	Cruise, and Approach or Landing.	Test for at least six cycles with stability augmentation off. CCA: Test in non-normal control mode.		X	X	

2.d.8	Steady State Sideslip.	For a given rudder position: ±2° roll angle; ±1° side-slip angle; ±2° or ±10% of aileron angle; and ±5° or ±10% of spoiler or equivalent roll controller position or force. 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.	Approach or Landing.	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 must be near maximum allowable rudder. (Level 5 and Level 6 FTD only): Sideslip angle is matched only for repeatability and only on continuing qualification evaluations.	X	X	X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	

2.e.	Landing							

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
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. CCA: Test in normal and non-normal control mode, if applicable.			X	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.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
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 Certified Landing Flap Configuration.	Test from a minimum of 61 m (200 ft) AGL to nosewheel touchdown. Test at near maximum certificated landing weight.			X	

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° side-slip 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. Test data is required, 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 must be provided as headwind and crosswind values with respect to the runway.			X	In those situations where a maximum crosswind or a maximum demonstrated crosswind is not known, contact the MSP.
2.e.4	One Engine Inoperative Landing.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA.	Landing	Test from a minimum of 61 m (200 ft) AGL to a 50% decrease in main landing gear touchdown speed.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
		± 3 m (10 ft) or $\pm 10\%$ of height. $\pm 2^\circ$ roll angle. $\pm 2^\circ$ side-slip angle. $\pm 3^\circ$ heading angle.						
2.e.5	Autopilot landing (if applicable).	± 1.5 m (5 ft) flare height. ± 0.5 s or $\pm 10\%$ 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 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 engage and main gear touchdown must be noted.			X	See Chapter 1 of this manual for definition of T_f .
2.e.6	All-engine autopilot go-around.	± 3 kt airspeed. $\pm 1.5^\circ$ pitch angle. $\pm 1.5^\circ$ AOA.	As per aeroplane performance data.	Normal all-engine autopilot go-around must be demonstrated (if applicable) at medium weight.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.e.7	One engine inoperative go around.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±2° roll angle. ±2° side-slip angle.	As per aeroplane performance data.	Engine inoperative go-around required near maximum certificated landing weight 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.			X	
2.e.8	Directional control (rudder effectiveness) with symmetric reverse thrust.	±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.			X	
2.e.9	Directional control (rudder effectiveness) with asymmetric reverse thrust.	±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.			X	
2.f.	Ground Effect							

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.f.	Test to demonstrate Ground Effect.	$\pm 1^\circ$ elevator angle. $\pm 0.5^\circ$ stabilizer angle. $\pm 5\%$ of net thrust or equivalent. $\pm 1^\circ$ AOA. ± 1.5 m (5 ft) or $\pm 10\%$ of height. ± 3 kt airspeed. $\pm 1^\circ$ pitch angle.	Landing	A rationale must be provided with justification of results. CCA: Test in normal or non-normal control mode, as applicable.	X			See Section 4.8 of Chapter 4 for additional information.
2.h.	Flight Maneuver And 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 their function is different) are required. Set thrust as required to reach the envelope protection function.							

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.h.1	Overspeed.	±5 kt airspeed.	Cruise				X	
2.h.2	Minimum Speed.	±3 kt airspeed.	Takeoff, Cruise, and Approach or Landing.				X	
2.h.3	Load Factor.	±0.1g normal load factor	Takeoff, Cruise				X	
2.h.4	Pitch Angle.	±1.5° pitch angle	Cruise, Approach				X	
2.h.5	Bank Angle.	±2° or ±10% bank angle	Approach				X	
2.h.6	Angle of Attack.	±1.5° angle of attack	2 nd Segment Climb, and Approach or Landing.				X	
4. VISUAL SYSTEM								
4.a.	Visual Scene Quality							

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
4.a.1	Continuous cross-cockpit visual field of view.	Cross-cockpit, collimated visual display providing each pilot with a minimum of 176° horizontal and 36° vertical continuous field of view.	Not applicable.	Required as part of MQTG but not required as part of continuing evaluations.			X	Field of view should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares. Installed alignment should be confirmed in an SOC (this would generally consist of results from acceptance testing).
4.a.2	System geometry	Geometry of image should have no distracting discontinuities.	Not applicable.	The angular spacing of any chosen 5° square and the relative spacing of adjacent squares must be within the stated tolerances.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Table C2A – Aeroplane Type-Specific FTD - Objective Tests								
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
4.a.3	Surface resolution (Object detection).	Not greater than 4 arc minutes.	Not applicable.	An SOC is required and must include the relevant calculations and an explanation of those calculations.			X	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 eye-point. 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.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
4.a.4	Light point size.	Not greater than 8 arc minutes.	Not applicable.	An SOC is required and must include the relevant calculations and an explanation of those calculations.			X	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 eye-point 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.
4.a.5	Raster surface contrast ratio.	Not less than 5:1.	Not applicable.				X	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 center of each channel. Measurement should be made on the center bright square for each channel using a 1° spot photometer. This value should have a minimum brightness of 7 cd/m² (2 ft-lamberts).

Table C2A – Aeroplane Type-Specific FTD - Objective Tests									
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes	
Entry #	Title				5	6	7		
								Measure any adjacent dark squares. The contrast ratio is the bright square value divided. 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 center of squares to avoid light spill into the measurement device.	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
4.a.6	Light point contrast ratio.	Not less than 10:1.	Not applicable.				X	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 1. — <i>Light point modulation should be just discernible on calligraphic systems but will not be discernable on raster systems.</i> Measurements of background should be taken such that the bright square is just out of the light meter FOV. Note 2. — <i>During contrast ratio testing, FSTD aft-cab and flight deck ambient light levels should be as low as practical.</i>

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
4.a.7	Light point brightness.	Not less than 20 cd/m2 (5.8 ft-lamberts).	Not applicable.				X	Light points should be displayed as a matrix creating a square. On calligraphic systems the light points should just merge. 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 14 cd/m2 (4.1 ft-lamberts) on the display.	Not applicable.				X	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.
4.b.	Head-Up Display (HUD)							

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
4.b.1	Static Alignment.	Static alignment with displayed image. HUD bore sight must align with the center of the displayed image spherical pattern. Tolerance +/- 6 arc min.	Not applicable.				X	Alignment requirement applies to any HUD system in use or both simultaneously if they are used simultaneously for training.
4.b.2	System display.	All functionality in all flight modes must be demonstrated.	Not applicable.				X	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				X	Alignment requirement only applies to the pilot flying.
4.c.	Enhanced Flight Vision System (EFVS)							

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
4.c.1	Registration test.	Alignment between EFVS display and out of the window image must represent the alignment typical of the aircraft and system type.	Takeoff point and on approach at 200 ft.				X	Alignment requirement only applies to the pilot flying. Note. — The effects of the alignment tolerance in 4.b.1 should be taken into account.
4.c.2	EFVS RVR and visibility calibration.	The scene represents the EFVS view at 350 m (1,200 ft) and 1,609 m (1 sm) RVR including correct light intensity.	Flight				X	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.				X	The scene will correctly represent the thermal characteristics of the scene during a day to night transition.
4.d.	Visual Ground Segment							
4.d.1	Visual ground segment (VGS).	Near end: the correct number of approach lights within the computed VGS must be visible.	Trimmed in the landing configuration at 30 m (100 ft) wheel height above touchdown	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:			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
		Far end: $\pm 20\%$ of the computed VGS. The threshold lights computed to be visible must be visible in the FTD.	zone on glide slope at an RVR setting of 300 m (1,000 ft) or 350 m (1,200 ft).	1) RVR/Visibility; 2) glide slope (G/S) and localizer modeling accuracy (location and slope) for an ILS; 3) for a given weight, configuration and speed representative of a point within the aeroplane's operational envelope for a normal approach and landing; and 4) Radio altimeter. Note. — <i>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.</i>				

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
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.				X	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, 6,000 light points, 16 moving models.	Not applicable.				X	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.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	

5. SOUND SYSTEM

Note: The sponsor will not be required to repeat the operational sound tests (i.e., tests 5.a.1. through 5.a.8 (or 5.b.1. through 5.b.9.) and 5.c., as appropriate) during continuing qualification evaluations if frequency response and background noise test results are within tolerance when compared to the initial qualification evaluation results, and the sponsor shows that no software changes have occurred that will affect the FTD's sound system. If the frequency response test method is chosen and fails, the sponsor may elect to fix the frequency response problem and repeat the test or the sponsor may elect to repeat the operational sound tests. If the operational sound tests are repeated during continuing qualification evaluations, the results may be compared against initial qualification evaluation results. All tests in this section must be presented using an un-weighted 1/3-octave band format from band 17 to 42 (50 Hz to 16 kHz). A minimum 20 second average must be taken at a common location from where the initial evaluation sound results were gathered.

5.a. Turbo-Jet Aeroplanes.

All tests in this section should be presented using an un-weighted 1/3-octave band format from at least band 17 to 42 (50 Hz to 16 kHz). A measurement of minimum 20 s should be taken at the location corresponding to the approved data set. The approved data set and FSTD results should be produced using comparable data analysis techniques. Refer to paragraph 4.10 of Chapter 4.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
5.a.1	Ready for engine start.	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.	Ground	Normal condition prior to engine start. The APU should be on if appropriate.			X	
5.a.2	All engines at idle.		Ground	Normal condition prior to takeoff.			X	
5.a.3	All engines at maximum allowable thrust with brakes set.		Ground	Normal condition prior to takeoff.			X	
5.a.4	Climb		Enroute climb.	Medium altitude.			X	
5.a.5	Cruise		Cruise.	Normal cruise configuration.			X	
5.a.6	Speed brake/spoilers extended (as appropriate).		Cruise	Normal and constant speed brake deflection for descent at a constant airspeed and power setting.			X	
5.a.7	Initial approach.		Approach.	Constant airspeed, gear up, flaps/slats as appropriate.			X	
5.a.8	Final approach.		Landing.	Constant airspeed,			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Table C2A – Aeroplane Type-Specific FTD - Objective Tests									
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes	
Entry #	Title				5	6	7		
5.b.	Propeller-Driven Aeroplanes								
	All tests in this section should be presented using an un-weighted 1/3-octave band format from at least band 17 to 42 (50 Hz to 16 kHz). A measurement of minimum 20 s should be taken at the location corresponding to the approved data set. The approved data set and FSTD results should be produced using comparable data analysis techniques. Refer to paragraph 4.10 of Chapter 4.								
5.b.1	Ready for engine start.	Initial evaluation: Subjective assessment of 1/3 octave bands.	Ground	Normal condition prior to engine start. The APU should be on if appropriate.			X		
5.b.2	All propellers feathered, if applicable.		Ground	Normal condition prior to takeoff.			X		
5.b.3	Ground idle or equivalent.		Ground.	Normal condition prior to takeoff.			X		

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
5.b.4	Flight idle or equivalent.	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 takeoff.			X	
5.b.5	All engines at maximum allowable power with brakes set.		Ground.	Normal condition prior to takeoff.			X	
5.b.6	Climb.		Enroute climb.	Medium altitude.			X	
5.b.7	Cruise		Cruise.	Normal cruise configuration.			X	
5.b.8	Initial approach.		Approach.	Constant airspeed, gear up, flaps extended as appropriate, RPM as per operating manual.			X	
5.b.9	Final approach.		Landing.	Constant airspeed, gear down, landing configuration flaps, RPM as per operating manual.			X	

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
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.					X	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 initial evaluation, it is 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. Where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
5.d.	FSTD background noise	Initial evaluation: background noise levels must fall below the sound levels described in Paragraph 4.10.3 e) of this Chapter. Recurrent evaluation: ± 3 dB per 1/3 octave band compared to initial evaluation.		Results of the background noise at initial qualification must be included in the QTG document and approved by the MSP. The measurements are to be made with the simulation running, the sound muted and a dead cockpit.			X	The simulated sound will be evaluated to ensure that the background noise does not interfere with training. Refer to Paragraph 4.10.3 e) of this Chapter. This test should be presented using an un-weighted 1/3 octave band format from band 17 to 42 (50 Hz to 16 kHz).

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)					X	Only required if the results are to be used during continuing qualification evaluations in lieu of aeroplane tests. The results must be approved by the MSP during the initial qualification. This test should be presented using an un-weighted 1/3 octave band format from band 17 to 42 (50 Hz to 16 kHz).

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	

6. SYSTEMS INTEGRATION

Table C2A – Aeroplane Type-Specific FTD - Objective Tests

Table C2A – Aeroplane Type-Specific FTD - Objective Tests									
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes	
Entry #	Title				5	6	7		
6.a.	System Response Time								
6.a.1	Transport delay.	Motion system and instrument response: 100 ms (or less) after aeroplane response. Visual system response: 120 ms (or less) after aeroplane response.	Pitch, roll and yaw.				X	One separate test is required in each axis. Where EFVS systems are installed, the EFVS response should be within + or - 30 ms from visual system response, and not before motion system response. Note. — <i>The delay from the aeroplane EFVS electronic elements should be added to the 30 ms tolerance before comparison with visual system reference.</i>	
6.a.1	Transport delay.	300 milliseconds or less after controller movement.	Pitch, roll and yaw.		X	X			

Small, Single and Multiengine Aeroplanes - FTD Level 5 - Alternative Objective Data

Table C2B detail acceptable FTD performance standards for level 5 FTDs that simulate small, single and multiengine aeroplanes. A sponsor must demonstrate that a device performs within the range of the applicable parameter. If a device does not meet the established performance parameters for some or for all of the applicable tests listed in Table C2B, the sponsor may use NSP accepted flight test data to validate the tests.

Sponsors using the data from Table C2B must comply with the following:

- a. Submit a complete QTG, including results from all of the objective tests appropriate for the level of qualification sought as set out in Table B2A. The QTG must highlight those results that demonstrate the performance of the FTD is within the allowable performance ranges indicated in Table C2B.
- b. The QTG test results must include all relevant information concerning the conditions under which the test was conducted; e.g., gross weight, center of gravity, airspeed, power setting, altitude (climbing, descending, or level), temperature, configuration, and any other parameter that impacts the conduct of the test.
- c. The test results become the validation data against which the initial and all subsequent continuing qualification evaluations are compared. These subsequent evaluations will use the tolerances listed in Table C2A.
- d. Subjective testing of the device must be performed to determine that the device performs and handles like an airplane within the appropriate set of airplanes.

Table C2B – FTD Level 5 - Alternative Data Source for - Small, Single and Multi-Engine Aeroplanes

Table C2B –FTD Level 5 - Alternative Data Source for - Small, Single and Multi-Engine Aeroplanes		
Test No.	Applicable Test Title and Procedure	Authorized Performance Range

Note: The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD. Test and procedures apply to both reciprocating and turboprop, single and multi-engine aeroplane FTDs where not specifically indicated.

1.c PERFORMANCE - CLIMB

Table C2B –FTD Level 5 - Alternative Data Source for - Small, Single and Multi-Engine Aeroplanes

Test No.	Applicable Test Title and Procedure	Authorized Performance Range
1.c.1	Normal climb with nominal gross weight, at best rate-of-climb airspeed.	Reciprocating - Single Engine - Climb rate = 500 - 1200 fpm (2.5 - 6 m/sec). Reciprocating - Multi-Engine - Climb airspeed = 95 – 115 knots. - Climb rate = 500 – 1500 fpm (2.5 – 7.5 m/sec) Turboprop - Single Engine - Climb airspeed = 95 – 115 knots. - Climb rate = 800 – 1800 fpm (4 - 9 m/sec) Turboprop - Multi-Engine - Climb airspeed = 120 – 140 knots. - Climb rate = 1000 – 3000 fpm (5 - 15 m/sec)
1.f PERFORMANCE - ENGINES		
1.f.1	Acceleration; idle to takeoff power.	Reciprocating - Single Engine: 2 - 4 Seconds. Reciprocating - Multi-Engine: 2 - 5 Seconds. Turboprop - Single Engine: 4 - 8 Seconds. Turboprop - Multi-Engine: 2 - 6 Seconds.
1.f.2	Deceleration; takeoff power to idle.	Reciprocating - Single Engine: 2 - 4 Seconds. Reciprocating - Multi-Engine: 2 - 5 Seconds. Turboprop - Single Engine: 3 - 7 Seconds. Turboprop - Multi-Engine: 1 - 5 Seconds.

Table C2B –FTD Level 5 - Alternative Data Source for - Small, Single and Multi-Engine Aeroplanes

Test No.	Applicable Test Title and Procedure	Authorized Performance Range
2.c HANDLING QUALITIES - LONGITUDINAL CONTROL TESTS		
2.c.1	Power change force.	Test (a) or (b) required
2.c.1.(a)	(a) Trim for straight and level flight at 80 percent of normal cruise airspeed with necessary power. Reduce power to flight idle. Do not change trim or configuration. After stabilized, record column force necessary to maintain original airspeed.	Reciprocating - Single Engine 5 - 15 lbs (2.2 - 6.6 daN) of force (Push). Reciprocating - Multi-Engine 10 - 25 lbs (2.2 - 6.6 daN) of force (Push). Turboprop - Single and Multi- Engine 8 lbs (3.5 daN) of Push force – 8 lbs (3.5 daN) of Pull force.
2.c.1.(b)	(b) Trim for straight and level flight at 80 percent of normal cruise airspeed with necessary power. Add power to maximum setting. Do not change trim or configuration. After stabilized, record column force necessary to maintain original airspeed.	Reciprocating - Single and Multi- Engine 5 - 15 lbs (2.2 - 6.6 daN) of force (Pull). Turboprop - Single and Multi- Engine 12 - 22 lbs (5.3 – 9.7 daN) of force (Pull).
2.c.2	Flap/slat change force.	Test 2.c.2.(a) or 2.c.2.(b) required
2.c.2.(a)	(a) Trim for straight and level flight with flaps fully retracted at a constant airspeed within the flaps-extended airspeed range. Do not adjust trim or power. Extend the flaps to 50 percent of full flap travel. After stabilized, record stick force necessary to maintain original airspeed.	5 - 15 lbs (2.2 - 6.6 daN) of force (Push).
2.c.2.(b)	(b) Trim for straight and level flight with flaps extended to 50 percent of full flap travel, at a constant airspeed within the flaps-extended airspeed range. Do not adjust trim or power. Retract the flaps to zero. After stabilized, record stick force necessary to maintain original airspeed.	5 - 15 lbs (2.2 - 6.6 daN) of force (Pull).
2.c.4	Gear change force.	Test (a) or (b) required

Table C2B –FTD Level 5 - Alternative Data Source for - Small, Single and Multi-Engine Aeroplanes

Test No.	Applicable Test Title and Procedure	Authorized Performance Range
2.c.4.(a)	(a) Trim for straight and level flight with landing gear retracted at a constant airspeed within the landing gear-extended airspeed range. Do not adjust trim or power. Extend the landing gear. After stabilized, record stick force necessary to maintain original airspeed.	2 - 12 lbs (0.88 - 5.3 daN) of force (Push).
2.c.4.(b)	(b) Trim for straight and level flight with landing gear extended, at a constant airspeed within the landing gear-extended airspeed range. Do not adjust trim or power. Retract the landing gear. After stabilized, record stick force necessary to maintain original airspeed.	2 - 12 lbs (0.88 - 5.3 daN) of force (Pull).
2.c.5	Longitudinal trim.	Must be able to trim longitudinal stick force to “zero” in each of the following configurations: cruise; approach; and landing.
2.c.7	Longitudinal static stability.	Must exhibit positive static stability.
2.c.8	Stall warning (actuation of stall warning device) with nominal gross weight; wings level; and a deceleration rate of not more than three (3) knots per second.	Test 2.c.8.(a) and 2.c.8.(b)
2.c.8.(a)	(a) Landing configuration.	Reciprocating and Turboprop - Single Engine 60 - 90 knots; ± 5 degree of bank. Reciprocating – Multi-Engine 60 - 90 knots; ± 5 degree of bank. Turboprop - Multi-Engine 80 - 100 knots; $\pm 5^\circ$ of bank.
2.c.8.(b)	(b) Clean configuration.	Landing configuration speed + 10 - 20%.
2.c.9.b	Phugoid dynamics.	Must have a Phugoid with a period of 30 - 60 seconds. Must not reach $\frac{1}{2}$ or double amplitude in less than 2 cycles.
2.d HANDLING QUALITIES - LATERAL DIRECTIONAL TESTS		

Table C2B –FTD Level 5 - Alternative Data Source for - Small, Single and Multi-Engine Aeroplanes

Test No.	Applicable Test Title and Procedure	Authorized Performance Range
2.d.2	Roll response. Roll rate must be measured through at least 30 degree of roll. Aileron control must be deflected 1/3 (33.3 percent) of maximum travel.	Must have a roll rate of 4- 25 degree /second.
2.d.4.c	Spiral stability. Cruise configuration and normal cruise airspeed. Establish a 20 degree – 30 degree bank. When stabilized, neutralize the aileron control and release. Must be completed in both directions of turn.	Initial bank angle (± 5 degree) after 20 seconds.
2.d.6.b	Rudder response. Use 25 percent of maximum rudder deflection. (Applicable to approach or landing configuration.)	Single Engine - Reciprocating • 2 - 6 degree /second yaw rate. Multi Engine - Reciprocating • 3 - 6 degree /second yaw rate. Turboprop – Single and Multi-engine • 3 - 6 degree /second yaw rate.
2.d.8	Steady state sideslip. Use 50 percent rudder deflection. (Applicable to approach and landing configurations.)	2 - 10 degree of bank; 4 - 10 degrees of sideslip; and 2 - 10 degree of aileron.
6. FTD SYSTEM RESPONSE TIME.		
6.a	Flight deck instrument systems response to an abrupt pilot controller input. One test is required in each axis (pitch, roll, and yaw).	300 milliseconds or less.

Aeroplane – Flight Training Device Level 6 - Alternative Data Sources, Procedures, and Instrumentation

1. Sponsors are not required to use the alternative data sources, procedures, and instrumentation. However, a sponsor may choose to use one or more of the alternative sources, procedures, and instrumentation described in Table C2C.
2. In the absence of flight test data, experienced FTD manufacturers have developed methods that use alternative data sources, procedures, and instrumentation to establish data bases for new FTD configurations. The manufacturer will then compare and validate the database against flight test data as it becomes available. The results of such comparisons have become increasingly consistent and when applied with appropriate experience, are becoming sufficiently accurate to develop aerodynamic models for use in Level 6 FTDs.
3. The MSP may accept alternative data sources from experienced FTD manufacturers for a Level 6 FTDs, provided that they can show that the quality of that simulation is not compromised.
4. Table C2C describes an acceptable alternative to data sources for Level 6 FTD modeling and validation, and an acceptable alternative to the procedures and instrumentation traditionally found in the flight test methods for gathering modeling and validation data.
 - a. Alternative data sources that may be used for part or all of a data requirement are the Aircraft Maintenance Manual, the Aircraft Flight Manual (AFM), Aircraft Design Data, the Type Inspection Report (TIR), Certification Data or acceptable supplemental flight test data.
 - b. The sponsor should contact the MSP prior to using the alternative instrumentation noted in Table C2C in a flight test or data gathering effort.
5. The MSP approval of these alternative data sources, procedures, and instrumentation is based on the following assumptions and conditions:
 - a. Data gathered through the alternative means does not require angle of attack (AOA) measurements or control surface position measurements for any flight test. AOA can be sufficiently derived if the flight test program ensures the collection of acceptable level, un-accelerated, trimmed flight data. Angle of attack may be validated by conducting the three basic “fly-by” trim tests. The FTD time history tests should begin in level, un-accelerated, and trimmed flight, and the results should be compared with the flight test pitch angle.
 - b. A simulation controls system model should be rigorously defined and fully mature. It should also include accurate gearing and cable stretch characteristics (where applicable) that are determined from actual aircraft measurements. Such a model does not require control surface position measurements in the flight test objective data for Level 6 FTD applications.
 - c. Table B2F is not applicable to Computer Controlled Aircraft FTDs.
 - d. The use of alternate data sources, procedures, and instrumentation does not relieve the sponsor from compliance with the balance of Level 6 FTDs requirements and information herein.
 - e. The term “inertial measurement system” allows the use of a functional global positioning system (GPS).

Table C2C – Aeroplane – Flight Training Device Level 6 - Alternative Data Sources, Procedures, and Instrumentation

Table C2C – Aeroplane - FTD Level 6 - Alternative Data Sources, Procedures, and Instrumentation			
Test No.	Test Name	Alternative Data Sources, Procedures, and Instrumentation	Notes/Information
Note: The standards in this table are required if the data gathering methods described in Section 5.3 of Chapter 5 are not used.			
1.b PERFORMANCE - TAKEOFF			
1.b.1	Ground acceleration time	Data may be acquired through a synchronized video recording of a stop watch and the calibrated aeroplane airspeed indicator.	This test is required only if RTO is sought.
1.b.7	Rejected takeoff.	Hand-record the flight conditions and aeroplane configuration.	
1.c PERFORMANCE - TAKEOFF			
1.c.1	Normal climb all engines operating.	Data may be acquired with a synchronized video of calibrated aeroplane instruments and engine power throughout the climb range.	
1.f PERFORMANCE - ENGINES			
1.f.1	Acceleration	Data may be acquired with a synchronized video recording of engine instruments and throttle position.	
1.f.2	Deceleration		
2.a HANDLING QUALITIES - STATIC CONTROL TESTS.			
2.a.1.a	Pitch controller position vs. force and surface position calibration	Surface position data may be acquired from flight data recorder (FDR) sensor or, if no FDR sensor, at selected, significant column positions (encompassing significant column position data points), acceptable to the MSP, using a control surface protractor on the ground. Force data may be acquired by using a hand held force gauge at the same column position data points.	For aeroplanes with reversible control systems, surface position data acquisition should be accomplished with winds less than 5 kts.
2.a.2.a	Wheel position vs. force and surface position calibration.		

Table C2C – Aeroplane - FTD Level 6 - Alternative Data Sources, Procedures, and Instrumentation

Test No.	Test Name	Alternative Data Sources, Procedures, and Instrumentation	Notes/Information
2.a.3.a	Rudder pedal position vs. force and surface position calibration.		
2.a.4	Static control tests. Nosewheel steering force.	Breakout data may be acquired with a hand held force gauge. The remainder of the force to the stops may be calculated if the force gauge and a protractor are used to measure force after breakout for at least 25% of the total displacement capability.	
2.a.5	Rudder pedal steering calibration.	Data may be acquired through the use of force pads on the rudder pedals and a pedal position measurement device, together with design data for nosewheel position.	
2.a.6	Pitch trim indicator vs. surface position calibration.	Data may be acquired through calculations.	
2.a.8	Alignment of power lever angle vs. selected engine parameter (e.g., EPR, N1, Torque, Manifold pressure).	Data may be acquired through the use of a temporary throttle quadrant scale to document throttle position. Use a synchronized video to record steady state instrument readings or hand-record steady state engine performance readings.	
2.a.9	Brake pedal position vs. force.	Use of design or predicted data is acceptable. Data may be acquired by measuring deflection at “zero” and at “maximum.”	
2.c HANDLING QUALITIES - LONGITUDINAL CONTROL TESTS			
2.c.1	Power change force.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated aeroplane instruments, throttle position, and the force/position measurements of flight deck controls.	Power change dynamics test is acceptable using the same data acquisition methodology.

Table C2C – Aeroplane - FTD Level 6 - Alternative Data Sources, Procedures, and Instrumentation

Test No.	Test Name	Alternative Data Sources, Procedures, and Instrumentation	Notes/Information
2.c.2	Flap/slat change force.	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated aeroplane instruments, flap/slat position, and the force/position measurements of flight deck controls.	Flap/slat change dynamics test is acceptable using the same data acquisition methodology.
2.c.4	Gear change force.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated aeroplane instruments, gear position, and the force/position measurements of flight deck controls.	Gear change dynamics test is acceptable using the same data acquisition methodology.
2.c.5	Longitudinal trim.	Data may be acquired through use of an inertial measurement system and a synchronized video of flight deck controls position (previously calibrated to show related surface position) and engine instrument readings.	
2.c.6	Longitudinal maneuvering stability (stick force/g).	Data may be acquired through the use of an inertial measurement system and a synchronized video of the calibrated aeroplane instruments; a temporary, high resolution bank angle scale affixed to the attitude indicator; and a wheel and column force measurement indication.	
2.c.7	Longitudinal static stability	Data may be acquired through the use of a synchronized video of the aeroplane flight instruments and a hand held force gauge.	
2.c.8	Stall Warning (activation of stall warning device).	Data may be acquired through a synchronized video recording of a stop watch and the calibrated aeroplane airspeed indicator. Hand-record the flight conditions and aeroplane configuration.	Airspeeds may be cross checked with those in the TIR and AFM.
2.c.9.a	Phugoid dynamics.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated aeroplane instruments and the force/position measurements of flight deck controls.	
2.c.10	Short period dynamics.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated aeroplane instruments and the force/position measurements of flight deck controls.	

Table C2C – Aeroplane - FTD Level 6 - Alternative Data Sources, Procedures, and Instrumentation

Test No.	Test Name	Alternative Data Sources, Procedures, and Instrumentation	Notes/Information
2.c.11	Gear and flap/slat operating times.	May use design data, production flight test schedule, or maintenance specification, together with an SOC.	
2.d HANDLING QUALITIES - LATERAL DIRECTIONAL TESTS			
2.d.2	Roll response (rate).	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated aeroplane instruments and the force/position measurements of flight deck lateral controls.	
2.d.3	(a) Roll overshoot. OR (b) Roll response to flight deck roll controller step input.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated aeroplane instruments and the force/position measurements of flight deck lateral controls.	
2.d.4	Spiral stability.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated aeroplane instruments; the force/position measurements of flight deck controls; and a stop watch.	
2.d.6.a	Rudder response.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated aeroplane instruments; the force/position measurements of rudder pedals.	
2.d.7	Dutch roll, (yaw damper OFF).	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated aeroplane instruments and the force/position measurements of flight deck controls.	
2.d.8	Steady state sideslip.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated aeroplane instruments and the force/position measurements of flight deck controls.	

Appendix C3 – Aeroplane Type-Specific Flight Training Device –Subjective Evaluation

Table C3A – Aeroplane Type-Specific FTD - Functions and Subjective Tests – Operations Tasks

Table C3A – Aeroplane Type-Specific FTD - Functions and Subjective Tests					
Entry No.	Operations Tasks	FTD Level			
		5	6	7	
Tasks in this table are subject to evaluation if appropriate for the airplane simulated as indicated in the FSTD Certificate Configuration List or the level of simulator qualification involved. Items not installed or not functional on the simulator and, therefore, not appearing on the FSTD Certificate Configuration List, are not required to be listed as exceptions on the FSTD Certificate.					
1. PREPARATION FOR FLIGHT					
1.a.	Pre-flight. Accomplish a functions check of all installed switches, indicators, systems, and equipment at all crewmembers' and instructors' stations, and determine that the flight deck (or flight deck area) design and functions replicate the appropriate aeroplane.	X	X	X	
1.a.2	The flight deck design and functions are identical to that of the airplane being simulated.			X	
2. SURFACE OPERATIONS (PRE-FLIGHT).					
2.a.	Engine Start				
2.a.1	Normal start	X	X	X	
2.a.2	Alternate start procedures	X	X	X	
2.a.3	Abnormal starts and shutdowns (e.g., hot/hung start, tail pipe fire)	X	X	X	
2.b.	Taxi				
2.b.1	Pushback/powerback			X	
2.b.2	Thrust response			X	
2.b.3	Power lever friction			X	
2.b.4	Ground handling			X	
2.b.5	Nosewheel scuffing	/	/	/	
2.b.6	Taxi aids (e.g. taxi camera, moving map)			X	
2.b.7	Low visibility (taxi route, signage, lighting, markings, etc.)			X	
2.c.	Brake Operation				
2.c.1	Brake operation (normal and alternate/emergency)			X	
2.c.2	Brake fade (if applicable)			X	
3. TAKE-OFF.					
3.a.	Normal				
3.a.1	Airplane/engine parameter relationships, including run-up		X	X	
3.a.2	Acceleration characteristics.		X	X	
3.a.3	Nosewheel and rudder steering		X	X	
3.a.3.a	Crosswind (maximum demonstrated)			X	
3.a.3.b	Gusting crosswind			X	
3.a.4	Special performance			X	
3.a.4.a	Reduced V1			X	
3.a.4.b	Maximum engine de-rate			X	
3.a.4.c	Soft surface			X	
3.a.4.d	Short field/short take-off and landing (STOL) operations			X	
3.a.4.e	Obstacle (performance over visual obstacle)			X	
3.a.5	Low visibility take-off			X	
3.a.6	Landing gear, wing flap leading edge device operation		X	X	
3.a.7	Contaminated runway operation			X	
3.b.	Abnormal/emergency				
3.b.1	Rejected Take-off / Deceleration characteristics		X	X	

Table C3A – Aeroplane Type-Specific FTD - Functions and Subjective Tests					
Entry No.	Operations Tasks	FTD Level			
		5	6	7	
3.b.2	Rejected special performance (e.g., reduced V1, max de-rate, short field operations)				X
3.b.3	Rejected take-off with contaminated runway				X
3.b.4	Takeoff with a propulsion system malfunction (allowing an analysis of causes, symptoms, recognition, and the effects on aircraft performance and handling) at the following points: (i) Prior to V1 decision speed; (ii) Between V1 and Vr (rotation speed); and (iii) Between Vr and 500 feet above ground level.				X
3.b.5	Flight control system failures, reconfiguration modes, manual reversion and associated handling.				X
4. CLIMB.					
4.a.	Normal.	X	X		X
4.b.	One or more engines inoperative.				X
4.c.	Approach climb in icing (for airplanes with icing accountability).				X
5. CRUISE.					
5.a.	Performance characteristics (speed vs. power, configuration, and attitude)	X	X		X
5.a.1	Straight and level flight		X		X
5.a.2	Change of airspeed.		X		X
5.a.3	High altitude handling. (For Level 6 – sufficient for demonstration only)		X		X
5.a.4	High Mach number handling (Mach tuck, Mach buffet) and recovery (trim change). (For Level 6 – sufficient for demonstration only)		X		X
5.a.5	Overspeed warning (in excess of Vmo or Mmo).		X		X
5.a.6	High IAS handling. (For Level 6 – sufficient for demonstration of Mach effects on control and trim only)				X
5.b.	Maneuvers				
5.b.1	High Angle of Attack		X		X
5.b.1.a	High angle of attack, approach to stalls, stall warning, and stall buffet (take-off, cruise, approach, and landing configuration) including reaction of the autoflight system and stall protection system.		X		X
5.b.1.b	Full stall				
5.b.2	Slow flight		X		X
5.b.3	Upset prevention and recovery maneuvers.				
5.b.4	Flight envelope protection (high angle of attack, bank limit, overspeed, etc.)				X
5.b.5	Turns with/without speedbrake/spoilers deployed				X
5.b.6	Normal and standard rate turns	X	X		X
5.b.7	Steep turns		X		X
5.b.8	Performance turn				X
5.b.9	In flight engine shutdown and restart (assisted and windmill) (For Level 6 – procedures only)		X		X
5.b.10	Maneuvering with one or more engines inoperative, as appropriate		X		X
5.b.11	Specific flight characteristics (e.g. direct lift control)				X
5.b.12	Flight control system failures, reconfiguration modes, manual reversion and associated handling (For Level 6 – procedures only)		X		X
5.b.13	Gliding to a forced landing				X
5.b.14	Operations during icing conditions.		X		X
5.b.15	Effects of airframe / engine icing.		X		X
5.b.14	Visual resolution and FSTD handling and performance for the following (where applicable by aircraft type and training program):				

Table C3A – Aeroplane Type-Specific FTD - Functions and Subjective Tests

Entry No.	Operations Tasks	FTD Level		
		5	6	7
5.b.14.a	Terrain accuracy for forced landing area selection;			X
5.b.14.b	Terrain accuracy for VFR Navigation;			X
5.b.14.c	Eights on pylons (visual resolution);			X
5.b.14.d	Turns about a point; and			X
5.b.14.e	S-turns about a road or section line.			X
6. DESCENT.				
6.a.	Normal	X	X	X
6.b.	Maximum rate/emergency (clean and with speedbrake, etc.).		X	X
6.c.	With autopilot.		X	X
6.d.	Flight control system failures, reconfiguration modes, manual reversion and associated handling.			X
7. INSTRUMENT APPROACHES AND LANDING.				
Note: Those instrument approach and landing tests relevant to the simulated airplane type are selected from the following list. Some tests are made with limiting wind velocities, under windshear conditions, and with relevant system failures, including the failure of the Flight Director. If Standard Operating Procedures allow use autopilot for non-precision approaches, evaluation of the autopilot will be included. The landing maneuver in an FTD is authorized for procedural training only and is not eligible for credits in a TC approved training program.				
7.a.	Precision approach (as applicable)			
7.a.1	CAT I published approaches.			
7.a.1.a	• Manual approach with/without flight director (including landing for Level 7 and Visual equipped Level 6).		X	X
7.a.1.b	• Autopilot/autothrottle coupled approach and manual landing (including landing for Level 7 and Visual equipped Level 6).		X	X
7.a.1.c	• Autopilot/autothrottle coupled approach, engine(s) inoperative.			X
7.a.1.d	• Manual approach, engine(s) inoperative.			X
7.a.1.e	• HUD/EFVS			X
7.a.2	CAT II published approaches.			
7.a.2.a	• Autopilot/autothrottle coupled approach to DH and landing (manual and auto-land).			X
7.a.2.b	• Autopilot/autothrottle coupled approach with one-engine- inoperative approach to DH and go-around (manual and autopilot).			X
7.a.2.c	• HUD/EFVS			X
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 auto-land).			X
7.a.3.b	• Autopilot/autothrottle coupled approach to DH and go-around (manual and autopilot).			X
7.a.3.c	• Autopilot/autothrottle coupled approach to land and roll-out (if applicable) guidance with one engine inoperative (manual and auto-land).			X
7.a.3.d	• Autopilot/autothrottle coupled approach to DH and go-around with one engine inoperative (manual and autopilot).			X
7.a.3.e	• HUD/EFVS			X
7.a.4	Autopilot/autothrottle coupled approach (Precision and Non-precision to a landing or to a go-around):			
7.a.4.a	With generator failure;			X
7.a.4.b.1	With maximum tail wind component certified or authorized			X
7.a.4.b.2	With 10 knot tail wind;		X	

Table C3A – Aeroplane Type-Specific FTD - Functions and Subjective Tests

Entry No.	Operations Tasks	FTD Level		
		5	6	7
7.a.4.c.1	With maximum crosswind component demonstrated or authorized			X
7.a.4.c.2	With 10 knot tail wind;		X	
7.a.5	PAR approach, all engine(s) operating and with one or more engine(s) inoperative			X
7.a.6	MLS, GBAS, all engine(s) operating and with one or more engine(s) inoperative			X
7.b.	Non-precision approach.			
7.b.1	Surveillance radar approach, all engine(s) operating and with one or more engine(s) inoperative			X
7.b.2	NDB approach, all engine(s) operating and with one or more engine(s) inoperative			X
7.b.3	VOR, VOR/DME, TACAN approach, all engine(s) operating and with one or more engine(s) inoperative			X
7.b.4	RNAV / RNP / GNSS (RNP at nominal and minimum authorized temperatures) approach, all engine(s) operating and with one or more engine(s) inoperative			X
7.b.5	ILS LLZ (LOC), LLZ back course (or LOC-BC) approach, all engine(s) operating and with one or more engine(s) inoperative			X
7.b.6	ILS offset localizer approach, all engine(s) operating and with one or more engine(s) inoperative			X
7.b.7	Manual approach with/without flight director including landing for visual equipped FTD. (For Level 5: as applicable for the systems installed).	X	X	
7.b.8	Autopilot/autothrottle coupled approach and manual landing including landing for visual equipped FTD. (For Level 5: as applicable for the systems installed).	X	X	
7.c	Approach procedures with vertical guidance (APV), e.g. SBAS, flight path vector			
7.c.1	APV/baro-VNAV approach, all engine(s) operating and with one or more engine(s) inoperative			X
7.c.2	Area navigation (RNAV) approach procedures based on SBAS, all engine(s) operating and with one or more engine(s) inoperative			X
8. VISUAL APPROACHES (VISUAL SEGMENT) AND LANDINGS.				
Note: Flight simulators with visual systems, which permit completing a special approach procedure in accordance with applicable regulations, may be approved for that particular approach procedure. The landing maneuver in an FTD is authorized for procedural training only and is not eligible for credits in a TC approved training program.				
8.a.	Maneuvering, normal approach and landing, all engines operating with and without visual approach aid guidance			X
8.b.	Approach and landing with one or more engines inoperative			X
8.c.	Operation of landing gear, flap/slats and speedbrakes (normal and abnormal)			X
8.d.1	Approach and landing with crosswind (max. demonstrated)			X
8.d.2	Approach and landing with gusting crosswind			X
8.e.	Approach and landing with flight control system failures, reconfiguration modes, manual reversion and associated handling (most significant degradation which is probable)			X
8.e.1	Approach and landing with trim malfunctions			X
8.e.1.a	Longitudinal trim malfunction			X
8.e.1.b	Lateral-directional trim malfunction			X
8.f.	Approach and landing with standby (minimum) electrical/hydraulic power			X
8.g.	Approach and landing from circling conditions (circling approach)			X
8.h.	Approach and landing from visual traffic pattern			X
8.i.	Approach and landing from non-precision approach			X
8.j.	Approach and landing from precision approach			X
9. MISSED APPROACH.				

Table C3A – Aeroplane Type-Specific FTD - Functions and Subjective Tests

Entry No.	Operations Tasks	FTD Level		
		5	6	7
9.a.	All engines, manual and autopilot (as applicable).		X	X
9.b.	Engine(s) inoperative, manual and autopilot.			X
9.c.	Rejected landing			X
9.d.	With flight control system failures, reconfiguration modes, manual reversion and associated handling			X
9.e.	Bounced landing recovery			
10. SURFACE OPERATIONS (landing, after-landing and post-flight).				
10.a	Landing roll and taxi			
10.a.1	HUD/EFVS			X
10.a.2	Spoiler operation			X
10.a.3	Reverse thrust operation			X
10.a.4	Directional control and ground handling, both with and without reverse thrust			X
10.a.5	Reduction of rudder effectiveness with increased reverse thrust (rear pod-mounted engines)			X
10.a.6	Brake and anti-skid operation			
10.a.6.a	Brake and anti-skid operation with dry, patchy wet, wet on rubber residue, and patchy icy conditions			X
10.a.6.b	Reserved			
10.a.6.c	Brake operation		X	
10.a.6.d	Auto-braking system operation			X
10.b	Engine shutdown and parking			
10.b.1	Engine and systems operation	X	X	X
10.b.2	Parking brake operation	X	X	X
11. ANY FLIGHT PHASE.				
11.a.	Airplane and engine systems operation (Where installed, the system must support type-specific procedural training for the simulated aircraft type)			
11.a.1	Air conditioning and pressurization (ECS)			X
11.a.2	De-icing/anti-icing		X	X
11.a.3	Auxiliary power unit (APU).			X
11.a.4	Communications		X	X
11.a.5	Electrical			X
11.a.6	Fire and smoke detection and suppression			X
11.a.7	Flight controls (primary and secondary)			X
11.a.8	Fuel and oil			X
11.a.9	Hydraulic			X
11.a.10	Pneumatic			X
11.a.11	Landing gear / Flap operation	X	X	X
11.a.12	Oxygen			X
11.a.13	Engine		X	X
11.a.14	Airborne radar			X
11.a.15	Autopilot and Flight Director		X	X
11.a.16	Terrain awareness warning systems and collision avoidance systems (e.g. EGPWS, GPWS, TCAS)			X
11.a.17	Flight control computers including stability and control augmentation			X
11.a.18	Flight display systems		X	X
11.a.19	Flight management computers			X
11.a.20	Head-up displays (including EFVS, if appropriate)			X
11.a.21	Navigation systems		X	X
11.a.22	Stall warning/avoidance		X	X
11.a.23	Wind shear avoidance/recovery guidance equipment			X

Table C3A – Aeroplane Type-Specific FTD - Functions and Subjective Tests

Entry No.	Operations Tasks	FTD Level		
		5	6	7
11.a.24	Flight envelope protections		X	X
11.a.25	Electronic flight bag			X
11.a.26	Automatic checklists (normal, abnormal and emergency procedures)		X	X
11.a.27	Runway alerting and advisory system			X
11.a.28	Normal system operation (installed systems)	X	X	
11.a.29	Abnormal/Emergency system operation (installed systems)	X	X	
11.b.	Airborne procedures			
11.b.1	Holding		X	X
11.b.2	Air hazard avoidance (traffic, weather, including visual correlation)			X
11.b.3	Windshear			
11.b.3.a	• Prior to take-off rotation			X
11.b.3.b	• At lift-off			X
11.b.3.c	• During initial climb			X
11.b.3.d	• On final approach, below 150 m (500 ft) AGL			X
11.b.4	Effects of airframe ice			

Table C3B – Aeroplane – FTD Level 7 - Airport Modeling Requirements - Functions and Subjective Tests

Table C3B – Aeroplane - FTD Level 7 - Functions and Subjective Tests	
Entry No.	Airport Modeling Requirements
<i>This table specifies the minimum airport model content and functionality to qualify a simulator at level 7. It applies only to the airport models required for FTD qualification.</i>	
1. Reserved	
2. ADDITIONAL FUNCTIONAL TEST CONTENT REQUIREMENTS	
2.a.1	AIRPORT SCENES
2.a.1.a	A minimum of three (3) real-world airport models to be consistent with published data used for airplane 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. The model identifications must be acceptable to the sponsor's TPAA, selectable from the IOS, and listed on the SOQ.
2.a.1.b, c	Reserved
2.a.1.d	Airport model content. For circling approaches, all tests apply to the runway used for the initial approach and to the runway of intended landing. If all runways in an airport model used to meet the requirements of this Appendix are not designated as "in use," then the "in use" runways must be listed on the SOQ (e.g., KORD, Rwy 9R, 14L, 22R). Models of airports with more than one runway must have all significant runways not "in-use" visually depicted for airport and runway recognition purposes. The use of white or off white light strings that identify the runway threshold, edges, and ends for twilight and night scenes are acceptable for this requirement. Rectangular surface depictions are acceptable for daylight scenes. A visual system's capabilities must be balanced between providing airport models with an accurate representation of the airport and a realistic representation of the surrounding environment. Airport model detail must be developed using airport pictures, construction drawings and maps, or other similar data, or developed in accordance with published regulatory material; however, this does not require that such models contain details that are beyond the design capability of the currently qualified visual system. Only one "primary" taxi route from parking to the runway end will be required for each "in-use" runway.
2.a.2	Visual scene fidelity.
2.a.2.a	The visual scene must correctly represent the parts of the airport and its surroundings used in the training program.
2.a.2.b, c	Reserved
2.a.3	Runways and taxiways.
2.a.3.a	Reserved.
2.a.3.b	Representative runways and taxiways.
2.a.3.c	Reserved
2.a.4	Reserved
2.a.5	Runway threshold elevations and locations must be modeled to provide correlation with airplane systems (e.g. HUD, GPS, compass, altimeter).
2.a.6	Reserved
2.a.7	Runway surface and markings for each "in-use" runway must include the following, if appropriate:
2.a.7.a	Threshold markings.
2.a.7.b	Runway numbers.
2.a.7.c	Touchdown zone markings.
2.a.7.d	Fixed distance markings.
2.a.7.e	Edge markings.
2.a.7.f	Center line markings.

Table C3B – Aeroplane - FTD Level 7 - Functions and Subjective Tests	
Entry No.	Airport Modeling Requirements
2.a.7.g, h	Reserved
2.a.7.i	Windsock that gives appropriate wind cues.
2.a.8	Runway lighting of appropriate colors, directionality, behavior and spacing for the “in-use” runway including the following:
2.a.8.a	Threshold lights.
2.a.8.b	Edge lights.
2.a.8.c	End lights.
2.a.8.d	Center line lights.
2.a.8.e	Touchdown zone lights.
2.a.8.f	Lead-off lights.
2.a.8.g	Appropriate visual landing aid(s) for that runway.
2.a.8.h	Appropriate approach lighting system for that runway.
2.a.9	Taxiway surface and markings (associated with each “in-use” runway):
2.a.9.a	Edge markings
2.a.9.b	Center line markings.
2.a.9.c	Runway holding position markings.
2.a.9.d	ILS critical area markings.
2.a.10	Taxiway lighting of appropriate colors, directionality, behavior and spacing (associated with each “in-use” runway):
2.a.10.a	Edge lights.
2.a.10.b	Center line lights.
2.a.10.c	Runway holding position and ILS critical area lights.
2.a.11	Required visual model correlation with other aspects of the airport environment simulation.
2.a.11.a	The airport model must be properly aligned with the navigational aids that are associated with operations at the runway “in-use”.
2.a.12	Airport buildings, structures and lighting.
2.a.12.a	Representative airport buildings, structures and lighting.
2.a.12.b	Reserved
2.a.12.c	Representative moving and static airport clutter (e.g. other airplanes, power carts, tugs, fuel trucks, additional gates).
2.a.13	Terrain and obstacles.
2.a.13.a	Reserved
2.a.13.b	Representative depiction of terrain and obstacles within 46 km (25 NM) of the reference airport.
2.a.14	Significant, identifiable natural and cultural features and moving airborne traffic.
2.a.14.a	Reserved
2.a.14.b	Significant, identifiable natural and cultural features within 46 km (25 NM) of the reference airport. <i>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.</i>
2.a.14.c	Representative moving airborne traffic (including the capability to present air hazards – e.g. airborne traffic on a possible collision course).
2.b VISUAL SCENE MANAGEMENT.	
2.b.1	Reserved
2.b.2	Airport runway, approach and taxiway lighting and cultural lighting intensity for any approach must 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.
2.c VISUAL FEATURE RECOGNITION.	
<i>Note. — The following are the minimum distances at which runway features should be visible. Distances are measured from runway threshold to an airplane aligned with the runway on an extended 3-degree glide slope in suitable simulated meteorological conditions. For circling approaches, all tests below apply both to the runway used for the initial approach and to the runway of intended landing.</i>	

Table C3B – Aeroplane - FTD Level 7 - Functions and Subjective Tests	
Entry No.	Airport Modeling Requirements
2.c.1	Runway definition, strobe lights, approach lights, and runway edge white lights from 8 km (5 sm) of the runway threshold.
2.c.2	Visual approach aids lights from 4.8 km (3 sm) of the runway threshold.
2.c.3	Runway center line lights and taxiway definition from 4.8 km (3 sm).
2.c.4	Threshold lights and touchdown zone lights from 3.2 km (2 sm).
2.c.5	Reserved
2.c.6	For circling approaches, the runway of intended landing and associated lighting must fade into view in a non-distracting manner.
2.d SELECTABLE AIRPORT VISUAL SCENE CAPABILITY FOR:	
2.d.1	Night.
2.d.2	Twilight.
2.d.3	Day.
2.d.4	Dynamic effects —the capability to present multiple ground and air hazards such as another airplane crossing the active runway or converging airborne traffic; hazards should be selectable via controls at the instructor station.
2.e CORRELATION WITH AIRPLANE AND ASSOCIATED EQUIPMENT.	
2.e.1	Visual cues to relate to actual airplane responses.
2.e.2	Visual cues to assess sink rate and depth perception during landings.
2.e.3	Accurate portrayal of environment relating to airplane attitudes.
2.e.4	The visual scene must correlate with integrated airplane systems, where fitted (e.g. terrain, traffic and weather avoidance systems and HUD/EFVS).
2.f SCENE QUALITY.	
2.f.1	Surfaces and textural cues must be free from apparent quantization (aliasing).
2.f.2	System capable of portraying full color realistic textural cues.
2.f.3	The system light points must be free from distracting jitter, smearing or streaking.
2.f.4	Reserved
2.f.5	System capable of providing light point perspective growth (e.g. relative size of runway and taxiway edge lights increase as the lights are approached).
2.g ENVIRONMENTAL EFFECTS.	
2.g.1 to 6	Reserved
2.g.7	Visibility and RVR measured in terms of distance. Visibility/RVR must 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.

Table C3D – Aeroplane – FTD Level 7 - Functions and Subjective Tests - Sound and IOS Requirements

Table C3D – Aeroplane - FTD Level 7 - Functions and Subjective Tests	
Entry No.	Sound and Instructor Operating System (IOS) Requirements
<i>This table specifies the minimum airport model content and functionality to qualify a simulator at level 7. It applies only to the airport models required for FTD qualification.</i>	
Sound System Requirements:	
The following sound checks are performed during a normal flight profile.	
1.	Precipitation.
2.	Reserved
3.	Significant airplane noises perceptible to the pilot during normal operations.
4.	Abnormal operations for which there are associated sound cues including, engine malfunctions, landing gear/tire malfunctions, tail and engine pod strike and pressurization malfunction.
5.	Sound of a crash when the flight simulator is landed in excess of limitations.
Instructor Operating Station (IOS) Requirements:	
IOS Functions in this table are subject to evaluation only if they are installed on the FTD and/or are appropriate for the aeroplane simulated.	
1.	Simulator Power Switch(es)
2.	Airplane conditions.
2.a.	Gross weight, center of gravity, fuel loading and allocation
2.b.	Airplane systems status.
2.c.	Ground crew functions (e.g., ext. power, push back)
3.	Airports.
3.a.	Number and selection.
3.b.	Runway selection.
3.c.	Runway surface condition (e.g., rough, smooth, icy, wet)
3.d.	Preset positions (e.g., ramp, gate, #1 for takeoff, takeoff position, over FAF)
3.e.	Lighting controls.
4.	Environmental controls.
4.a.	Visibility (statute miles (kilometers)).
4.b.	Runway visual range (in feet (meters)).
4.c.	Temperature.
4.d.	Climate conditions (e.g., ice, snow, rain).
4.e.	Wind speed and direction.
4.f.	Windshear.
4.g.	Clouds (base and tops).
5.	Airplane system malfunctions (Inserting and deleting malfunctions into the simulator).
6.	Locks, Freezes, and Repositioning.
6.a.	Problem (all) freeze / release.
6.b.	Position (geographic) freeze / release.
6.c.	Repositioning (locations, freezes, and releases).
6.d.	Ground speed control.
7.	Remote IOS. (if installed)
8.	Sound Controls. On / off / adjustment
9.	Control Loading System.
9.a.	On / off / emergency stop.
10.	Observer Seats / Stations. Position / Adjustment

Table C3E– Aeroplane – FTD Level 4 - Functions and Subjective Tests

Table C3E– Aeroplane – FTD Level 4 - Functions and Subjective Tests				
Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
Tasks training levels indicated in this table are recommendations based on subject to evaluation of systems installed in the FTD. They are meant to provide guidance to the TPAA responsible for approving air operator training programs that employ the device. Final approval for credits in an approved training program will rest solely with the TPAA. (See Section 5.10 of Chapter 5 for further guidance).				
LEGEND				
PT – suitable for procedural knowledge training.				
ST – suitable for skill training related to task.				
MT – suitable for manoeuvre training & checking for the task.				
“N” – Denotes that the device is not suitable or not applicable to task.				
1. 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	
Taxi		N	N	
Thrust response		N	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				
Rejected special performance take-off		N	N	
Failure of critical engine at V1		N	N	
Flight control system failure modes		N	N	
Wind shear		N	N	
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 stalls:				

Table C3E– Aeroplane – FTD Level 4 - Functions and Subjective Tests

Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
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	
Approaches				
Non-precision approach with autopilot:				
1) LOC/BC				
2) LOC				
3) NDB				
4) VOR				
5) GNSS				
6) RNAV				
7) RNP				
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) GNSS			N	
6) RNAV			N	
7) RNP			N	
With one or more engines inoperative		N	N	
Precision approach:				
ILS:				
CAT I – Autopilot			N	
CAT I – Manual:			N	
1) With flight director			N	
2) Without flight director			N	
CAT II:			N	
1) Auto-coupled			N	
2) Auto-throttle operations			N	
3) Autoland operations			N	
CAT III			N	

Table C3E– Aeroplane – FTD Level 4 - Functions and Subjective Tests

Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
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	
Missed Approach				
With autopilot:			N	
1) normal missed approach			N	
2) with an engine inoperative			N	
3) with engine failure during G/A		N	N	
Manual missed approach:			N	
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				
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	

Table C3E– Aeroplane – FTD Level 4 - Functions and Subjective Tests				
Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
Flight controls modes:				
Normal characteristics			N	
Abnormal characteristics		N	N	
Fuel and oil				
Hydraulics:				
Normal characteristics				
Abnormal characteristics		N	N	
Landing gear:				
Normal operations				
Alternate/emergency operations				
Oxygen				
Pneumatics				
Engines:				
Normal characteristics			N	
Abnormal characteristics			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				
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	
GNSS or performance-based navigation (RNP)			N	
Stall warning/avoidance		N	N	
GPWS/EGPWS		N	N	
Wind shear warning/avoidance		N	N	
Airborne procedures				
Holding				
Air hazard avoidance			N	

Table C3E– Aeroplane – FTD Level 4 - Functions and Subjective Tests

Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
Instructor operating station (IOS)			Functions	
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			☐	

Appendix D1 – Rotorcraft Type-Specific Flight Training Device – General Simulator Requirements.

7. This Appendix describes the general requirements for qualifying Level 4 through Level 7 FTDs. The sponsor should also consult the objectives tests in Table D2A of this appendix and the functions and subjective tests listed in Table D3A of this appendix to determine the complete requirements for a specific level FTD.
8. The general simulator requirements are divided into the following categories:
 - a. General Flight Deck Configuration.
 - b. Programming.
 - c. Equipment Operation.
 - d. Equipment and Facilities for Instructor/Evaluator Functions.
 - e. Motion System.
 - f. Visual System.
 - g. Sound System.
9. Table D1A provides the standards for the General FTD Requirements.
10. Table D1B provides the operational tasks that the sponsor will examine to determine whether the FTD satisfactorily meets the requirements for flight crew training, testing, and experience.
11. Table D1C provides the functions that an instructor/check airman must be able to control in the simulator.

Table D1A – Rotorcraft Type-Specific FTD - Minimum Simulator Requirements

Table D1A – Rotorcraft Type-Specific FTD - Minimum Simulator Requirements							
Entry No.	Minimum FTD Requirements	FTD Level				Notes	
		4	5	6	7		
1. GENERAL FLIGHT DECK CONFIGURATION							
1.a.	The FTD must have a flight deck that is a replica of the rotorcraft, or set of rotorcrafts simulated with controls, equipment, observable flight deck indicators, circuit breakers, and bulkheads properly located, functionally accurate and replicating the rotorcraft or set of rotorcrafts. The direction of movement of controls and switches must be identical to that in the rotorcraft or set of rotorcrafts. Crewmember seats must afford the capability for the occupant to be able to achieve the design “eye position.” Equipment for the operation of the flight deck windows must be included, but the actual windows need not be operable. Those circuit breakers that affect procedures or result in observable flight deck indications must be properly located and functionally accurate. Fire axes, extinguishers, landing gear pins, and spare light bulbs must be available, and may be represented in silhouette, in the flight simulator. This equipment must be present as near as practical to the original position.				X	X	For FTD purposes, the flight deck consists of all that space forward of a cross section of the flight deck at the most extreme aft setting of the pilots' seats including additional, required crewmember duty stations and those required bulkheads aft of the pilot seats. Bulkheads containing only items such as landing gear pin storage compartments, fire axes and extinguishers, spare light bulbs, and aircraft documents pouches are not considered essential and may be omitted. If omitted, these items, or the silhouettes of these items, may be placed on the wall of the simulator, or in any other location as near as practical to the original position of these items.
1.b.	The FTD must have equipment (i.e., instruments, panels, systems, circuit breakers, and controls) simulated sufficiently for the authorized training/checking events to be accomplished. The installed equipment, must be located in a spatially correct configuration, and may be in a flight deck or an open flight deck area. Those circuit breakers that affect procedures or result in observable flight deck indications must be properly located and functionally accurate. Additional equipment required for the authorized training and checking events must be available in the FTD but may be located in a suitable location as near as practical to the spatially correct position. Actuation of this equipment must replicate the appropriate function in the rotorcraft. Fire axes, landing gear pins, and any similar purpose instruments need only be represented in silhouette.	X	X				

Table D1A – Rotorcraft Type-Specific FTD - Minimum Simulator Requirements

Table D1A – Rotorcraft Type-Specific FTD - Minimum Simulator Requirements							
Entry No.	Minimum FTD Requirements	FTD Level				Notes	
		4	5	6	7		
2. PROGRAMMING							
2.a.	The FTD must provide the proper effect of aerodynamic changes for the combinations of drag and thrust normally encountered in flight. This must include the effect of change in rotorcraft attitude, thrust, drag, altitude, temperature, and configuration. Levels 6 and 7 additionally require the effects of changes in gross weight and center of gravity. Level 5 requires only generic aerodynamic programming. An SOC is required.		X	X	X		
2.b.	The FTD must have the computer (analog or digital) capability (i.e., capacity, accuracy, resolution, and dynamic response) needed to meet the qualification level sought. An SOC is required.	X	X	X	X		

Table D1A – Rotorcraft Type-Specific FTD - Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level				Notes
		4	5	6	7	
2.c.	Relative responses of the flight deck instruments must be measured by latency tests or transport delay tests, and may not exceed 150 milliseconds. The instruments must respond to abrupt input at the pilot's position within the allotted time, but not before the time that the rotorcraft or set of rotorcrafts respond under the same conditions. 1) <u>Latency</u>: The FTD instrument and, if applicable, the motion system and the visual system response must not be prior to that time when the rotorcraft responds and may respond up to 150 milliseconds after that time under the same conditions. 2) <u>Transport Delay</u>: As an alternative to the Latency requirement, a transport delay objective test may be used to demonstrate that the FTD system does not exceed the specified limit. The sponsor must measure all the delay encountered by a step signal migrating from the pilot's control through all the simulation software modules in the correct order, using a handshaking protocol, finally through the normal output interfaces to the instrument display and, if applicable, the motion system, and the visual system.		X	X	X	The intent is to verify that the FTD provides instrument cues that are, within the stated time delays, like the rotorcraft responses. For rotorcraft response, acceleration in the appropriate, corresponding rotational axis is preferred.
3. EQUIPMENT OPERATION.						
3.a	All relevant instrument indications involved in the simulation of the rotorcraft must automatically respond to control movement or external disturbances to the simulated rotorcraft or set of rotorcrafts; e.g., turbulence or winds.	X	X	X	X	Level 4 –may be assessed if the appropriate aircraft system or control are installed.

Table D1A – Rotorcraft Type-Specific FTD - Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level				Notes
		4	5	6	7	
3.b.	Navigation equipment must be installed and operate within the tolerances applicable for the rotorcraft or set of rotorcrafts. Levels 6 and 7 must also include communication equipment (inter-phone and air/ground) like that in the rotorcraft. Level 5 only needs that navigation equipment necessary to fly an instrument approach.	X	X	X	X	Level 4 –may be assessed if the appropriate aircraft system or control are installed.
3.c.	Installed systems must simulate the applicable rotorcraft system operation both on the ground and in flight. At least one rotorcraft system must be represented. Systems must be operative to the extent that applicable normal, abnormal, and emergency operating procedures included in the sponsor's training programs can be accomplished. Levels 6 and 7 must simulate all applicable rotorcraft flight, navigation, and systems operation. Level 5 must have functional flight and navigational controls, displays, and instrumentation.	X	X	X		Level 4 –may be assessed if the appropriate aircraft system or control are installed.
3.d	The lighting environment for panels and instruments must be sufficient for the operation being conducted.	X	X	X	X	Back-lighted panels and instruments may be installed but are not required.
3.e	The FTD must provide control forces and control travel that correspond to the replicated rotorcraft or set of rotorcrafts. Control forces must react in the same manner as in the rotorcraft or set of rotorcrafts under the same flight conditions.			X	X	
3.f.	The FTD must provide control forces and control travel of sufficient precision to manually fly an instrument approach. The control forces must react in the same manner as in the rotorcraft or set of rotorcrafts under the same flight conditions.		X			
4. INSTRUCTOR OR EVALUATOR FACILITIES.						
4. a.	In addition to the flight crewmember stations, the FTD must have suitable seating arrangement for the instructor/ACP and TC inspector. These seats must provide adequate view of crewmember's panel(s).	X	X	X	X	These seats need not be a replica of an aircraft seat and may be as simple as an office chair placed in an appropriate position.

Table D1A – Rotorcraft Type-Specific FTD - Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level				Notes
		4	5	6	7	
4.b.	The FTD must have instructor controls that permit activation of normal, abnormal, and emergency conditions as appropriate. Once activated, proper system operation must result from system management by the crew and not require input from the instructor controls.	X	X	X	X	
5. MOTION SYSTEM.						
5.a.	A motion system may be installed in an FTD. If installed, the motion system operation must not be distracting. If a motion system is installed and additional training, testing, or checking credits are being sought, sensory cues must also be integrated. The motion system must respond to abrupt input at the pilot's position within the allotted time, but not before the time when the rotorcraft responds under the same conditions. The motion system must be measured by latency tests or transport delay tests and may not exceed 150 milliseconds. Instrument response must not occur prior to motion onset.	X	X	X	X	
5.b.	The FTD must have at least a vibration cueing system for characteristic rotorcraft vibrations noted at the pilot station(s).				X	May be accomplished by a "seat shaker" or a bass speaker sufficient to provide the necessary cueing.
6. VISUAL SYSTEM.						
6.a.	The FTD may have a visual system, if desired, although it is not required. If a visual system is installed, it must meet the following criteria:					
6.a.1	The visual system must respond to abrupt input at the pilot's position. An SOC is required.	X	X	X		
6.a.2	The visual system must be at least a single channel, non-collimated display. An SOC is required.	X	X	X		
6.a.3	The visual system must provide at least a field-of-view of 18° vertical / 24° horizontal for the pilot flying. An SOC is required.	X	X	X		
6.a.4	The visual system must provide for a maximum parallax of 10° per pilot. An SOC is required.	X	X	X		
6.a.5	The visual scene content may not be distracting. An SOC is required.	X	X	X		

Table D1A – Rotorcraft Type-Specific FTD - Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level				Notes
		4	5	6	7	
6.a.6	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. An SOC is required.	X	X	X		
6.a.7	The visual system must provide for a minimum resolution of 5 arc-minutes for both computed and displayed pixel size. An SOC is required.	X	X	X		
6.b.	If a visual system is installed and additional training, testing, or checking credits are being sought on the basis of having a visual system, a visual system meeting the standards set out for at least a Level A FFS (see Appendix A of this manual) will be required. A "direct-view," non-collimated visual system (with the other requirements for a Level A visual system met) may be considered satisfactory for those installations where the visual system design "eye point" is appropriately adjusted for each pilot's position such that the parallax error is at or less than 10° simultaneously for each pilot. An SOC is required.	X	X	X		
6.c.	The FTD must provide a continuous visual field-of-view of at least 146° horizontally and 36° vertically for both pilot seats, simultaneously. The minimum horizontal field-of-view coverage must be plus and minus one-half (½) of the minimum continuous field-of-view requirement, centered on the zero degree azimuth line relative to the aircraft fuselage. Additional horizontal field-of-view capability may be added at the sponsor's discretion provided the minimum field-of-view is retained. Capability for a field-of-view in excess of these minima is not required for qualification at Level 7. However, where specific tasks require extended fields of view beyond the 146° by 36° (e.g., to accommodate the use of "chin windows" where the accommodation is either integral with or separate from the primary visual system display), then such extended fields of view must be provided. An SOC is required and must explain the geometry of the installation.				X	Optimization of the vertical field-of-view may be considered with respect to the specific rotorcraft flight deck cut-off angle. When considering the installation/use of augmented fields of view, as described here, it will be the responsibility of the sponsor to meet with the MSP to determine the training, testing, checking, or experience tasks for which the augmented field-of-view capability may be critical to that approval.
7. SOUND SYSTEM						
7.a.	The FTD must simulate significant flight deck sounds resulting from pilot actions that correspond to those heard in the rotorcraft.			X	X	

Table D1B - Rotorcraft Type Specific Flight Training Device – Minimum Subjective Requirements - Task vs. Flight Training Device Level

“(a)” - indicates that the system, task, or procedure, although not required to be present, may be included if the appropriate rotorcraft system is simulated in the FTD and is working properly.

Note: (a)* - For Level 4 FTDs, see Section 5.10 for subjective evaluation method.

Note: Items not installed or not functional on the FTD and not appearing on the Qualification Certificate Configuration List, are not required to be listed as exceptions on the Qualification Certificate.

Table D1B - Rotorcraft Type-Specific FTD - Minimum Subjective Requirements					
Entry #	Task vs. FTD Level	FTD Level			
		4	5	6	7
In order to be qualified at the FTD qualification level indicated by the (X), the simulator must be able to perform at least the tasks indicated herein.					
1. PREFLIGHT PROCEDURES.					
1.a.	Pre-flight Inspection (Flight deck Only) switches, indicators, systems, and equipment.	(a)*	(a)	X	X
1.b.	APU/Engine start and run-up.				
1.b.1	Normal start procedures.	(a)*	(a)	X	X
1.b.2	Alternate start procedures.	(a)*	(a)	X	X
1.b.3	Abnormal starts and shutdowns (hot start, hung start).	(a)*	(a)	X	X
1.c.	Taxiing – Ground.				X
1.d.	Taxiing – Hover.				X
1.e.	Pre-takeoff Checks	(a)*	(a)	X	X
2. TAKEOFF AND DEPARTURE PHASE.					
2.a.	Normal and Crosswind Takeoff				
2.a.1	From ground.				X
2.a.2	From hover.				X
2.a.3	Running.				X
2.b.	Instrument Takeoff			X	X
2.c.	Powerplant Failure During Takeoff			X	X
2.d.	Rejected Takeoff				X
2.e.	Instrument Procedure			X	X
3. CLIMB					
3.a.	Normal.			X	X
3.b.	Obstacle clearance.				X
3.c.	Vertical.			X	X
3.d.	One engine inoperative.			X	X
4. INFLIGHT MANEUVERS.					
4.a.	Turns (timed, normal, steep).		X	X	X
4.b.	Powerplant Failure - Multiengine Rotorcrafts.			X	X
4.c.	Powerplant Failure - Single-Engine Rotorcrafts.			X	X
4.d.	Recovery From Unusual Attitudes.				X
3.f.	Settling with Power.				X
5. INSTRUMENT PROCEDURES					
5.a.	Instrument Arrival.			X	X
5.b.	Holding			X	X

Table D1B - Rotorcraft Type-Specific FTD - Minimum Subjective Requirements					
Entry #	Task vs. FTD Level	FTD Level			
		4	5	6	7
5.c.	Precision Instrument Approach:				
5.c.1	All engines operating.		X	X	X
5.c.2	Manually controlled - One or more engine inoperative.			X	X
5.d.	Non-precision Instrument Approach.		X	X	X
5.e	Missed Approach :				
5.e.1	Normal.			X	X
5.e.2	One or more engines inoperative.			X	X
5.e.3	Stability augmentation system failure.			X	X
6. LANDINGS AND APPROACHES TO LANDINGS.					
6.a.	Visual Approaches (normal, steep, shallow).		X	X	X
	Landing From a Precision / Non-Precision Approach				(t)
6.b.	Landing:				
6.b.1. a	Running - (Normal and crosswind).				X
6.b.1. b	From Hover - (Normal and crosswind).				X
6.b.2	One or more engines inoperative.				X
6.b.3	Rejected Landing				X
7. NORMAL AND ABNORMAL PROCEDURES.					
7.a.	Powerplant.	(a)*	(a)	X	X
7.b.	Fuel System	(a)*	(a)	X	X
7.c.	Electrical System	(a)*	(a)	X	X
7.d.	Hydraulic System	(a)*	(a)	X	X
7.e.	Environmental Systems	(a)*	(a)	X	X
7.f.	Fire Detection and Extinguisher Systems	(a)*	(a)	X	X
7.g.	Navigation and Avionics Systems	(a)*	(a)	X	X
7.h.	Automatic Flight Control System, Electronic Flight Instrument System, and Related Subsystems	(a)*	(a)	X	X
7.i	Flight Control Systems	(a)*	(a)	X	X
7.j.	Anti-ice and Deice Systems	(a)*	(a)	X	X
7.k	Aircraft and Personal Emergency Equipment	(a)*	(a)	X	X
7.l.	Special Missions tasks (e.g., Night Vision goggles, Forward Looking Infrared System, External Loads and as listed on the FSTD Certificate.)				
8. EMERGENCY PROCEDURES. (As applicable)					
8.a.	Emergency Descent (Max. Rate)			X	X
8.b.	Inflight Fire and Smoke Removal			X	X
8.c.	Emergency Evacuation			X	X
8.d.	Ditching.				X
8.e.	Autorotation Landing.				X
8.f.	Retreating blade stall recovery.				X
8.g.	Mast bumping.				X
8.h.	Loss of tail rotor effectiveness.			X	X
9.a.	After-Landing Procedures	(a)*	(a)	X	X
9.b.	Parking and Securing	(a)*	(a)	X	X
9.b.1	Rotor brake operation.	(a)*	(a)	X	X

Table D1B - Rotorcraft Type-Specific FTD - Minimum Subjective Requirements

Entry #	Task vs. FTD Level	FTD Level			
		4	5	6	7
9.b.2	Abnormal/emergency procedures.	(a)*	(a)	X	X
INSTRUCTOR OPERATING STATION (IOS).					
1.a.	Power switch (es).	(a)*	X	X	X
1.b.	Rotorcraft conditions (e.g., GW, CG, Fuel loading and Systems.)	(a)*	(a)	X	X
1.c.	Airports / Heliports / Rotorcraft Landing Areas (e.g., Selection, Surface, Pre-sets, Lighting controls.)	(a)*	X	X	X
1.d.	(e.g., Clouds, Visibility, RVR, Temp, Wind, Ice, Snow,. Appropriate defaults for nominal flight conditions on system boot up.)	(a)*	X	X	X
1.e.	Rotorcraft system malfunctions (insertion / deletion)	(a)*	(a)	X	X
1.f.	Locks, Freezes, and Repositioning	(a)*	X	X	X
1.g.	Sound Controls - On / Off / adjustment		X	X	X
1.h.	Motion / Control Loading System. - On / Off / emergency stop		(a)	X	X
2. OBSERVER SEATS / STATIONS					
2.a	Position / Adjustment / Position restraint system.	(a)*	(a)	X	X

Appendix D2 – Rotorcraft Type-Specific Flight Training Device – Objective Tests

Introduction

4. If relevant winds are present in the objective data, the wind vector (magnitude and direction) should be clearly noted as part of the data presentation, expressed in conventional terminology, and related to the runway being used for the test.
5. The format for numbering the objective tests in Chapter 4, Appendix B2, Table B2A the objective tests in Table D2A, is identical. However, each test required for FFSSs is not necessarily required for FTDs, and each test required for FTDs is not necessarily required for FFSSs. When a test number (or series of numbers) is not required, the term “Reserved” is used in the table at that location. Following this numbering format provides a degree of commonality between the two tables and substantially reduces the potential for confusion when referring to objective test numbers for either FFSSs or FTDs.
6. A Level 4 FTD does not require objective tests and is therefore omitted from Table D2A.

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests								
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
1. PERFORMANCE								
1.a.	Engine Assessment							
1.a.1	Start Operations							
1.a.1.a	Engine start and acceleration (transient).	Light Off Time - ±10% or ±1 sec., Torque - ±5%, Rotor Speed - ±3%, Fuel Flow - ±10%, Gas Generator Speed - ±5%, Power Turbine Speed - ±5%, Gas Turbine Temp. - ±30°C	Ground with: Rotor Brake Used and Rotor Brake Not Used,	Record each engine start from the initiation of the start sequence to steady state idle and from steady state idle to operating RPM.		X	X	
1.a.1.b	Steady State Idle and Operating RPM conditions.	Torque - ±3%, Rotor Speed - ±1.5%, Fuel Flow - ±5%,	Ground	Record both steady state idle and operating RPM conditions. May be a series of snapshot tests.	X	X	X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
		Gas Generator Speed - $\pm 2\%$, Power Turbine Speed - $\pm 2\%$, Turbine Gas Temp. - $\pm 20^\circ\text{C}$.						
1.a.2	Power Turbine Speed Trim	$\pm 10\%$ of total change of power turbine speed, or $\pm 0.5\%$ change of rotor speed.	Ground	Record engine response to trim system actuation in both directions.		X	X	
1.a.3	Engine and Rotor Speed Governing	Torque - $\pm 5\%$, Rotor Speed - 1.5%.	Climb and descent	Record results using a step input to the collective. May be conducted concurrently with climb and descent performance tests.		X	X	
1.b	Reserved							
1.c.	Takeoff:							
1.c.1	All Engines	Airspeed - ± 3 kt, Altitude - ± 20 ft (6.1m), Torque - $\pm 3\%$,	Ground / Takeoff	Record results of takeoff flight path (running takeoff and takeoff from a hover). The criteria apply only to those segments at airspeeds above effective translational lift. Results must			X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
		Rotor Speed - $\pm 1.5\%$, Vertical Velocity - ± 100 fpm (0.50m/sec) or 10% , Pitch Attitude - $\pm 1.5^\circ$, Bank Attitude - $\pm 2^\circ$, Heading - $\pm 2^\circ$, Longitudinal Control Position - $\pm 10\%$, Lateral Control Position - $\pm 10\%$, Directional Control Position - $\pm 10\%$, Collective Control Position - $\pm 10\%$.	and Initial Segment of Climb.	be recorded from the initiation of the takeoff to at least 200 ft (61 m) AGL.				
1.c.2	Reserved							
1.c.3	Reserved							

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
1.d	HOVER Performance	Torque - $\pm 3\%$, Pitch Attitude - $\pm 1.5^\circ$, Bank Attitude - $\pm 1.5^\circ$, Longitudinal Control Position - $\pm 5\%$, Lateral Control Position - $\pm 5\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$.	In Ground Effect (IGE); and Out of Ground Effect (OGE).	Record results for light and heavy gross weights. May be a series of snapshot tests.			X	
1.e.	VERTICAL CLIMB Performance	Vertical Velocity - ± 100 fpm (0.50 m/sec) or $\pm 10\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$.	From OGE Hover.	Record results for light and heavy gross weights. May be a series of snapshot tests.			X	
1.f.	LEVEL FLIGHT Performance and Trimmed	Torque - $\pm 3\%$, Pitch Attitude - $\pm 1.5^\circ$, Sideslip Angle - $\pm 2^\circ$,	Cruise (Augmentation)	Record results for two gross weight and CG combinations with varying trim speeds throughout the airspeed envelope. May be a series of snapshot tests.	X	X	X	This test validates performance at speeds above maximum endurance airspeed

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
	Flight Control Positions.	Longitudinal Control Position - $\pm 5\%$, Lateral Control Pos'n - $\pm 5\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$.	On and Off).					
1.g.	CLIMB Performance and Trimmed Flight Control Positions.	Vertical Velocity - ± 100 fpm (6.1m/sec) or $\pm 10\%$, Pitch Attitude - $\pm 1.5^\circ$, Sideslip Angle - $\pm 2^\circ$, Longitudinal Control Position - $\pm 5\%$, Lateral Control Pos'n - $\pm 5\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$.	All engines operating; One engine inoperative; Augmentation System(s) On and Off.	Record results for two gross weight and CG combinations. The data presented must be for normal climb power conditions. May be a series of snapshot tests.	X	X	X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests								
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
1.h.	DESCENT :							
1.h.1	Descent Performance and Trimmed Flight Control Positions.	Torque - ±3%, Pitch Attitude - ±1.5°, Sideslip Angle - ±2° Longitudinal Control Position - ±5%, Lateral Control Pos'n - ±5%, Directional Control Position - ±5%, Collective Control Position - ±5%.	At or near 1,000 fpm (5 m/sec) rate of descent (RoD) at normal approach speed. Augmentation System(s) On and Off.	Results must be recorded for two gross weight and CG combinations. May be a series of snapshot tests.	X	X	X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
1.h.2	Autorotation Performance and Trimmed Flight Control Positions.	Pitch Attitude - $\pm 1.5^\circ$, Sideslip Angle - $\pm 2^\circ$, Longitudinal Control Position - $\pm 5\%$, Lateral Control Position - $\pm 5\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$ Vertical Velocity ± 100 fpm or 10%, Rotor Speed $\pm 1.5\%$.	Steady descents. Augmentation System(s) On and Off.	Record results for two gross weight conditions. Data must be recorded for normal operating RPM. (Rotor speed tolerance applies only if collective control position is full down.) Data must be recorded for speeds from 50 kts, ± 5 kts, through at least maximum glide distance airspeed, or maximum allowable autorotation airspeed, whichever is slower. May be a series of snapshot tests.	X	X	X	
1.i.	AUTO-ROTATION Entry.	Rotor Speed - $\pm 3\%$ Pitch Attitude $\pm 2^\circ$ Roll Attitude - $\pm 3^\circ$ Yaw Attitude - $\pm 5^\circ$ Airspeed - ± 5 kts. Vertical Velocity - ± 200 fpm (1.00 m/sec) or 10%.	Cruise or Climb.	Record results of a rapid throttle reduction to idle. If the cruise condition is selected, comparison must be made for the maximum range airspeed. If the climb condition is selected, comparison must be made for the maximum rate of climb		X	X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
				airspeed at or near maximum continuous power.				
1.j.	LANDING:							
1.j.1	All Engines.	Airspeed - ± 3 kts. Altitude - ± 20 ft. (6.1m), Torque - $\pm 3\%$, Rotor Speed - $\pm 1.5\%$, Pitch Attitude - $\pm 1.5^\circ$, Bank Attitude - $\pm 1.5^\circ$, Heading - $\pm 2^\circ$, Longitudinal Control Position - $\pm 10\%$, Lateral Control Position - $\pm 10\%$, Directional Control Position - $\pm 10\%$,	Approach.	Record results of the approach and landing profile (running landing or approach to a hover). The criteria apply only to those segments at airspeeds above effective translational lift. Record the results from 200 ft. AGL (61m) to the landing or to where the hover is established prior to landing.			X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
		Collective Control Position - $\pm 10\%$.						
1.j.2	Reserved.							
1.j.3	Reserved.							
1.j.4	Autorotational Landing.	Torque - $\pm 3\%$, Rotor Speed - $\pm 3\%$, Vertical Velocity - ± 100 fpm (0.50m/sec) or 10% , Pitch Attitude - $\pm 2^\circ$, Bank Attitude - $\pm 2^\circ$, Heading - $\pm 5^\circ$, Longitudinal Control Position - $\pm 10\%$, Lateral Control Position - $\pm 10\%$, Directional Control Position - $\pm 10\%$, Collective Control Position - $\pm 10\%$.	Landing.	Record the results of an autorotational deceleration and landing from a stabilized autorotational descent, to touch down. If flight test data containing all required parameters for a complete power-off landing is not available from the aircraft manufacturer for this test and other qualified flight test personnel are not available to acquire this data, the sponsor may coordinate with the MSP to determine if it is appropriate to accept alternative testing means.			x	Alternative approaches for acquiring this data may be acceptable, depending on the aircraft as well as the personnel and the data recording, reduction, and interpretation facilities to be used, are: 1) a simulated autorotational flare and reduction of rate of descent (ROD) at altitude; or 2) a power-on termination following an autorotational approach and flare.

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests								
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2. HANDLING QUALITIES								
2.a	Control System Mechanical Characteristics							
	For simulators requiring Static or Dynamic tests at the controls (i.e., cyclic, collective, and pedal), special test fixtures will not be required during initial or upgrade evaluations if the sponsor's QTG/MQTG shows both test fixture results and the results of an alternative approach, such as computer plots produced concurrently showing satisfactory agreement. Repeat of the alternative method during the initial or upgrade evaluation satisfies this test requirement. For initial and upgrade evaluations, the control dynamic characteristics must be measured at and recorded directly from the flight deck controls, and must be accomplished in hover, climb, cruise, and autorotation.							
	Contact the MSP for clarification of any issue regarding rotorcrafts with reversible controls or where the required validation data is not attainable.							
2.a.1	Cyclic.	Breakout - ±0.25 lbs. (0.112 daN) or 25%; Force - ±1.0 lb. (0.224 daN) or 10%.	Ground; Static conditions. Trim On and Off. Friction Off Augmentation On and Off.	Record results for an uninterrupted control sweep to the stops. (This test does not apply if aircraft hardware modular controllers are used.)	X	X	X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.a.2	Collective / Pedals	Breakout - ± 0.5 lb. (0.224 daN) or 25%; Force - ± 1.0 lb. (0.224 daN) or 10%.	Ground; Static conditions. Trim On and Off. Friction Off Augmentation On and Off.	Record results for an uninterrupted control sweep to the stops.	X	X	X	
2.a.3	Brake Pedal Force vs. Position.	± 5 lbs. (2.224 daN) or 10%.	Ground; Static conditions.		X	X	X	
2.a.4	Trim System Rate (all applicable systems)	Rate - $\pm 10\%$.	Ground; Static conditions.	The tolerance applies to the recorded value of the trim rate.	X	X	X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
			Trim On, Friction Off.					
2.a.5	Control Dynamics (all axes)	±10% of time for first zero crossing and ±10 (N+1) % of period thereafter, ±10% of amplitude of first overshoot, 20% of amplitude of 2nd and subsequent overshoots greater than 5% of initial displacement, ±1 overshoot.	Hover/Cruise Trim On, Friction Off.	Results must be recorded for a normal control displacement in both directions in each axis, using 25% to 50% of full throw.		X	X	Control Dynamics for irreversible control systems may be evaluated in a ground/static condition. Additional information on control dynamics is found in Section 4.7 of this Chapter. "N" is the sequential period of a full cycle of oscillation.
2.a.6	Control System Free play	±0.10 inches (±2.5 mm).	Ground; Static conditions;	Record and compare results for all controls.	X	X	X	
2.b	LOW AIRSPEED HANDLING QUALITIES							
2.b.1	Trimmed Flight Control Positions.	Torque - ±3% Pitch Attitude - ±1.5°	Translational Flight IGE –	Record results for several airspeed increments to the translational airspeed limits and for 45 kts forward airspeed.			X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
		Bank Attitude - $\pm 2^\circ$ Longitudinal Control Position - $\pm 5\%$. Lateral Control Position - $\pm 5\%$ Directional Control Position - $\pm 5\%$ Collective Control Position - $\pm 5\%$.	Sideward, rearward, and forward flight. Augmentation On and Off.	May be a series of snapshot tests.				
2.b.2	Critical Azimuth	Torque - $\pm 3\%$ Pitch Attitude - $\pm 1.5^\circ$, Bank Attitude - $\pm 2^\circ$, Longitudinal Control Position - $\pm 5\%$, Lateral Control Position - $\pm 5\%$, Directional Control Position - $\pm 5\%$, Collective Control Position - $\pm 5\%$.	Stationary Hover. Augmentation On and Off.	Record results for three relative wind directions (including the most critical case) in the critical quadrant. May be a series of snapshot tests.			X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests								
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.b.3	CONTROL RESPONSE							
2.b.3.a	Longitudinal	Pitch Rate - ±10% or ±2°/sec. Pitch Attitude Change - ±10% or 1.5°.	Hover. Augmentation On and Off.	Record results for a step control input. The Off-axis response must show correct trend for unaugmented cases.			X	This is a “short time” test conducted in a hover, in ground effect, without entering translational flight, to provide better visual reference.
2.b.3.b	Lateral	Roll Rate - ±10% or ±3°/sec. Roll Attitude Change - ±10% or ±3°.	Hover Augmentation On and Off.	Record results for a step control input. The Off-axis response must show correct trend for unaugmented cases.			X	This is a “short time” test conducted in a hover, in ground effect, without entering translational flight, to provide better visual reference.
2.b.3.c	Directional	Yaw Rate - ±10% or ±2°/sec. Heading Change - ±10% or ±2°.	Hover Augmentation On and Off.	Record results for a step control input. The Off-axis response must show correct trend for unaugmented cases.			X	This is a “short time” test conducted in a hover, in ground effect, without entering translational flight, to provide better visual reference.
2.b.3.d	Vertical	Normal Acceleration – ±0.1 g.	Hover Augmentation On and Off.	Record results for a step control input. The Off-axis response must show correct trend for unaugmented cases.			X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests								
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.c.	LONGITUDINAL HANDLING QUALITIES							
2.c.1	Control Response	Pitch Rate - ±10% or ±2°/sec., Pitch Attitude Change - ±10% or ±1.5°.	Cruise Augmentation On and Off.	Results must be recorded for two cruise airspeeds to include minimum power required speed. Record data for a step control input. The Off-axis response must show correct trend for unaugmented cases.	X	X	X	
2.c.2	Static Stability	Longitudinal Control Position: ±10% of change from trim or ±0.25 in. (6.3 mm) or Longitudinal Control Force: ±0.5 lb. (0.223 daN) or ±10%.	Cruise or Climb. Autorotation. Augmentation On and Off.	Record results for a minimum of two speeds on each side of the trim speed. May be a series of snapshot tests.	X	X	X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.c.3	Dynamic Stability							
2.c.3.a	Long Term Response.	±10% of calculated period, ±10% of time to ½ or double amplitude, or ±0.02 of damping ratio. For non-periodic responses, the time history must be matched within ±3° pitch; and ±5 kts airspeed over a 20 sec period following release of the controls.	Cruise Augmentation On and Off.	For periodic responses, record results for three full cycles (6 overshoots after input completed) or that sufficient to determine time to ½ or double amplitude, whichever is less. For non-periodic responses, the test may be terminated prior to 20 sec. if the test pilot determines that the results are becoming uncontrollably divergent. If this method fails to excite the test, displace the cyclic to the predetermined maximum desired pitch attitude and return to the original position. If this method is used, record the results.	X	X	X	The response may be unrepeatable throughout the stated time for certain rotorcrafts. In these cases, the test should show at least that a divergence is identifiable. For example: displacing the cyclic for a given time normally excites this test or until a given pitch attitude is achieved and then return the cyclic to the original position. For non-periodic responses, results should show the same convergent or divergent character as the flight test data.
2.c.3.b	Short Term Response.	±1.5° Pitch or ±2°/sec. Pitch Rate. ±0.1 g Normal Acceleration.	Cruise or Climb. Augmentation On and Off.	Record results for at least two airspeeds.		X	X	A control doublet inserted at the natural frequency of the aircraft normally excites this test. However, while input doublets are preferred over pulse inputs for Augmentation-Off tests, for Augmentation-On tests,

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
								when the short term response exhibits 1st-order or deadbeat characteristics, longitudinal pulse inputs may produce a more coherent response.
2.c.4	Maneuvering Stability.	Longitudinal Control Position - $\pm 10\%$ of change from trim or ± 0.25 in. (6.3 mm) or Longitudinal Control Forces - ± 0.5 lb. (0.223 daN) or $\pm 10\%$.	Cruise or Climb. Augmentation On and Off.	Record results for at least two airspeeds at 30° - 45° roll angle. The force may be shown as a cross plot for irreversible systems. May be a series of snapshot tests.		X	X	
2.d	LATERAL AND DIRECTIONAL HANDLING QUALITIES							
2.d.1.a	CONTROL RESPONSE Lateral	Roll Rate - $\pm 10\%$ or $\pm 3^\circ/\text{sec.}$, Roll Attitude Change - $\pm 10\%$ or $\pm 3^\circ$.	Cruise Augmentation On and Off.	Record results for at least two airspeeds, including the speed at or near the minimum power required airspeed. Record results for a step control input. The Off-axis response must show correct trend for unaugmented cases.	X	X	X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
2.d.1.b	CONTROL RESPONSE Directional	Yaw Rate - $\pm 10\%$ or $\pm 2^\circ/\text{sec.}$, Yaw Attitude Change - $\pm 10\%$ or $\pm 2^\circ$.	Cruise Augmentation On and Off.	Record data for at least two airspeeds, including the speed at or near the minimum power required airspeed. Record results for a step control input. The Off-axis response must show correct trend for unaugmented cases.	X	X	X	
2.d.2	Directional Static Stability	Lateral Control Position - $\pm 10\%$ of change from trim or ± 0.25 in. (6.3 mm) or Lateral Control Force - ± 0.5 lb. (0.223 daN) or 10%, Roll Attitude - ± 1.5 , Directional Control Position - $\pm 10\%$ of change from trim or ± 0.25 in. (6.3 mm) or Directional Control Force - ± 1 lb. (0.448 daN) or 10%, Longitudinal Control Position - $\pm 10\%$ of change from trim or ± 0.25 in. (6.3 mm)	Cruise; or Climb (may use Descent instead of Climb if desired), Augmentation On and Off.	Record results for at least two sideslip angles on either side of the trim point. The force may be shown as a cross plot for irreversible systems. May be a series of snapshot tests.	X	X	X	This is a steady heading sideslip test at a fixed collective position

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
		Vertical Velocity - ± 100 fpm (0.50m/sec) or 10%.						
2.d.3	DYNAMIC LATERAL AND DIRECTIONAL STABILITY							
2.d.3.a	Lateral-Directional Oscillations	± 0.5 sec. or $\pm 10\%$ of period, $\pm 10\%$ of time to $\frac{1}{2}$ or double amplitude or ± 0.02 of damping ratio, $\pm 20\%$ or ± 1 sec of time difference between peaks of bank and sideslip. For non-periodic responses, the time history must be matched within ± 10 knots Airspeed; $\pm 5^\circ/\text{s}$ Roll Rate or $\pm 5^\circ$ Roll Attitude; $\pm 4^\circ/\text{s}$ Yaw Rate or $\pm 4^\circ$ Yaw Angle over a 20 sec period roll angle following release of the controls.	Cruise or Climb. Augmentation On and Off.	Record results for at least two airspeeds. The test must be initiated with a cyclic or a pedal doublet input. Record results for six full cycles (12 overshoots after input completed) or that sufficient to determine time to $\frac{1}{2}$ or double amplitude, whichever is less. The test may be terminated prior to 20 sec if the test pilot determines that the results are becoming uncontrollably divergent.	X	X	X	
2.d.3.b	Spiral Stability	$\pm 2^\circ$ or $\pm 10\%$ roll angle.	Cruise or Climb. Augmentation On and Off.	Record the results of a release from pedal only or cyclic only turns for 20 sec. Results must be recorded from turns in both directions. Terminate check at zero roll angle	X	X	X	

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
				or when the test pilot determines that the attitude is becoming uncontrollably divergent.				
2.d.3.c	Adverse/ Proverse Yaw	Correct Trend, $\pm 2^\circ$ transient sideslip angle.	Cruise or Climb. Augmentation On and Off.	Record the time history of initial entry into cyclic only turns, using only a moderate rate for cyclic input. Results must be recorded for turns in both directions.	X	X		
3. Reserved								
4. VISUAL SYSTEM								
4.a.	Visual System Response Time (Choose either test 4.a.1. or 4.a.2. to satisfy test 4.a., Visual System Response Time Test. This test is also sufficient for motion system response timing and flight deck instrument response timing.)							

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
4.a.1	Latency	150 ms (or less) after rotorcraft response.	Takeoff, climb, and descent.	One test is required in each axis (pitch, roll and yaw) for each of the three conditions (take-off, cruise, and approach or landing).			X	
4.a.2	Transport Delay	150 ms (or less) after controller movement.	N/A	A separate test is required in each axis (pitch, roll, and yaw).			X	
4.b.	Field-of-view							
4.b.1	Reserved							
4.b.2	Continuous field-of-view.	Minimum continuous field-of-view providing 146° horizontal and 36° vertical field-of-view for each pilot simultaneously and any geometric error between the Image Generator eye point and the pilot eye point is 8° or less.	N/A	An SOC is required and must explain the geometry of the installation. Horizontal field-of-view of at least 146° (including not less than 73° measured either side of the center of the design eye point). Additional horizontal field-of-view capability may be added at the sponsor's discretion provided the minimum field-of-view is retained. Vertical field-of-view of at least 36° measured from the pilot's and co-pilot's eye point.			X	Horizontal field-of-view is centered on the zero degree azimuth line relative to the aircraft fuselage.
4.b.3	Reserved.							

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
4.c	Surface contrast ratio.	Not less than 5:1.	N/XA	The ratio is calculated by dividing the brightness level of the center, bright square (providing at least 2 foot-lamberts or 7 cd/m2) by the brightness level of any adjacent dark square.			X	Measurements may be made using a 1° spot photometer and a raster drawn test pattern filling the entire visual scene (all channels) with a test pattern of black and white squares, 5 per square, with a white square in the center of each channel. During contrast ratio testing, simulator aft-cab and flight deck ambient light levels should be zero.
4.d	Highlight brightness.	Not less than six (6) foot-lamberts (20 cd/m2).	N/A	Measure the brightness of the center, white square while superimposing a highlight on that white square. The use of calligraphic capabilities to enhance the raster brightness is acceptable; however, measuring light points is not acceptable.			X	Measurements may be made using a 1° spot photometer and a raster drawn test pattern filling the entire visual scene (all channels) with a test pattern of black and white squares, 5 per square, with a white square in the center of each channel.

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
4.e	Surface resolution.	Not greater than two (2) arc minutes.	N/A	An SOC is required and must include the appropriate calculations and an explanation of those calculations. Level B requires surface resolution not greater than three (3) arc minutes.			X	When the eye is positioned on a 3° glide slope at the slant range distances indicated with white runway markings on a black runway surface, the eye will subtend two (2) arc minutes: (1) A slant range of 6,876 ft with stripes 150 ft long and 16 ft wide, spaced 4 ft apart. (2) For Configuration A; a slant range of 5,157 feet with stripes 150 ft long and 12 ft wide, spaced 3 ft apart. (3) For Configuration B; a slant range of 9,884 feet, with stripes 150 ft long and 5.75 ft wide, spaced 5.75 ft apart.
4.f	Light point size.	Not greater than five (5) arc-minutes.	N/A	An SOC is required and must include the relevant calculations and an explanation of those calculations.			X	Light point size may be measured using a test pattern consisting of a

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
								centrally located single row of light points reduced in length until modulation is just discernible in each visual channel. A row of 48 lights will form a 4° angle or less.
4.g	Light point contrast ratio. A 1° spot photometer may be used to measure a square of at least 1° filled with light points (where light point modulation is just discernible) and compare the results to the measured adjacent background. During contrast ratio testing, simulator aft-cab and flight deck ambient light levels should be zero.							
4.g.1	Reserved							
4.g.2	Light point contrast ratio.	Not less than 25:1.	N/A	An SOC is required and must include the relevant calculations.			x	

4.h.	Visual ground segment	The visible segment in the simulator must be $\pm 20\%$ of the segment computed to be visible from the rotorcraft flight deck. This tolerance may be applied at the far end of the displayed segment. However, lights and ground objects computed to be visible from the rotorcraft flight deck at the near end of the visible segment must be visible in the simulator.	Landing configuration, with the aircraft trimmed for the appropriate airspeed, where the MLG are at 100 ft (30m) above the plane of the touchdown zone, on the electronic glide slope with an RVR value set at 1,200 ft (350m).	The QTG must contain appropriate calculations and a drawing showing the data used to establish the rotorcraft location and the segment of the ground that is visible considering design eye point, the rotorcraft attitude, flight deck cut-off angle, and a visibility of 1200 ft (350 m) RVR. Simulator performance must be measured against the QTG calculations. The data submitted must include at least the following: (1) Static rotorcraft dimensions as follows: • Horizontal and vertical distance from main landing gear (MLG) to glideslope reception antenna. • Horizontal and vertical distance from MLG to pilot's eye point. • Static flight deck cut-off angle. (2) Approach data as follows: • Identification of runway. • Horizontal distance from runway threshold to glideslope intercept with runway. • Glideslope angle. (iv) Rotorcraft pitch angle on approach. (3) Rotorcraft data for manual testing: • Gross weight. • Rotorcraft configuration. • Approach airspeed. If non-homogenous fog is used to obscure visibility, the vertical variation in horizontal visibility must be described and be included			x	Pre-position for this test is encouraged, and may be achieved via manual or autopilot control to the desired position.

Table D2A – Rotorcraft – Type-Specific FTD - Objective Tests								
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry #	Title				5	6	7	
				in the slant range visibility calculation used in the computations.				

Appendix D3 – Rotorcraft Type-Specific Flight Training Device - Subjective Evaluation

Table D3A – Rotorcraft – FTD Level 5 to 7 - Functions and Subjective Tests

Table D3A – Rotorcraft Type-Specific FTD Level 5 to 7 - Functions and Subjective Tests					
Entry No.	Operations Tasks	FTD Level			
		5	6	7	
Tasks in this table are subject to evaluation if appropriate for the rotorcraft simulated as indicated in the FSTD Certificate Configuration List or the level of simulator qualification involved. Items not installed or not functional are not required to be listed as exceptions on the FSTD Certificate.					
1. PREPARATION FOR FLIGHT					
1.a	Flight deck check: switches, indicators, systems, and equipment.	X	X	X	
2. APU/ENGINE START AND RUN-UP.					
2.a	Normal start procedures.	X	X	X	
2.b	Alternate start procedures.	X	X	X	
2.c	Abnormal starts and shutdowns (e.g., hot start, hung start)	X	X	X	
2.d	Rotor engagement.		X	X	
2.e	System checks.		X	X	
3. TAXIING – GROUND					
3.a	Power required to taxi.			X	
3.b	Brake effectiveness.			X	
3.c	Ground handling.			X	
3.e	Abnormal/emergency procedures, as required for training - For example:				
3.e.1	• Brake system failure.			X	
3.e.2	• Ground resonance.			X	
3.e.5	• Others listed on the FSTD Certificate.			X	
4. TAXIING – HOVER					
4.a	Takeoff to a hover.			X	
4.b	Instrument response.				
4.b.1	• Engine instruments.			X	
4.b.2	• Flight instruments.			X	
4.b.3	• Hovering turns.			X	
4.c	Hover power checks.				
4.c.1	• In ground effect (IGE).			X	
4.c.2	• Out of ground effect (OGE).			X	
4.d	Crosswind/tailwind hover.			X	
4.e	Reserved				
4.f	Reserved				
4.g	Abnormal/emergency procedures:				
4.g.1	• Engine failure.			X	
4.g.2	• Fuel governing system failure.			X	
4.g.3	• Settling with power (OGE).			X	
4.g.5	• Stability augmentation system failure.			X	
4.g.6	• Directional control malfunction.			X	
4.g.7	• Loss of tail rotor effectiveness (LTE).			X	
4.g.8	• Others listed on the FSTD Certificate.			X	
4.h	Pre-takeoff checks.				
5. Reserved					
6. TAKEOFF AND DEPARTURE PHASE.					
6.a	Normal.				

Table D3A – Rotorcraft Type-Specific FTD Level 5 to 7 - Functions and Subjective Tests

Entry No.	Operations Tasks	FTD Level		
		5	6	7
6.a.1	• From ground.			X
6.a.2	• From hover.			X
6.a.3	• Running.			X
6.a.4	• Crosswind/tailwind.			X
6.a.5	• Maximum performance.			X
6.a.6	• Instrument.		X	X
6.b	Abnormal/emergency procedures:			
6.b.1	• Takeoff with engine failure after critical decision point (CDP).		X	X
6.c	Rejected takeoff.			
6.c.1	• Procedure to Landing			X
6.d	Instrument departure			X
6.e	Others listed on the FSTD Certificate.			X
7. CLIMB.				
7.a	Normal.	X	X	X
7.b	Obstacle clearance.			X
7.c	Vertical.			X
7.d	One engine inoperative.			X
7.e	Others listed on the FSTD Certificate.			X
8. INFLIGHT MANOEUVRES				
8.a	Performance.	X	X	X
8.b	Flying qualities.		X	X
8.c	Turns.			
8.c.1	• Timed.		X	X
8.c.2	• Normal.	X	X	X
8.c.3	• Steep.		X	X
8.d	Accelerations and decelerations.		X	X
8.e	High speed vibrations.			X
8.f	Reserved			
8.g	Abnormal/emergency procedures, as required for training - For example:			
8.g.1	• Engine fire.		X	X
8.g.2	• Engine failure.		X	X
8.g.2.a	○ Powerplant Failure - Multiengine Rotorcrafts.		X	X
8.g.2.b	○ Powerplant Failure - Single-Engine Rotorcrafts.		X	X
8.g.3	• Inflight engine shutdown (and restart if applicable).		X	X
8.g.4	• Fuel governing system failures. (e.g. FADEC malfunction).		X	X
8.g.5	• Directional control malfunction.		X	X
8.g.6	• Hydraulic failure.		X	X
8.g.7	• Stability system failure.		X	X
8.g.8	• Rotor vibrations.			X
8.g.9	• Recovery from unusual attitudes			X
8.h	Others listed on the FSTD Certificate.			X
9. DESCENT.				
9.a	Normal.		X	X
10. APPROACH PROCEDURES				
X¹ - Coupled instrument approach maneuvers (as applicable for the systems installed).				
10.a.	Non-Precision Instrument Approach:			
10.a.1	Instrument Procedures			
10.a.1.a	• NDB	X ¹	X	X
10.a.1.b	• VOR, RNAV, TACAN, GNSS, RNP	X ¹	X	X

Table D3A – Rotorcraft Type-Specific FTD Level 5 to 7 - Functions and Subjective Tests

Entry No.	Operations Tasks	FTD Level		
		5	6	7
10.a.1.c	• ASR		X	X
10.a.1.d	• Circling			X
10.a.1.e	• Rotorcraft only.		X	X
10.a.2	Normal - All engines operating.	X ¹	X	X
10.a.3	One or more engines inoperative.		X	X
10.a.4	Others listed on the FSTD Certificate.	X ¹		X
10.b	Precision Instrument Approach:			
10.b.1	Approach procedures			
10.b.1.a	• PAR		X	X
10.b.1.b	• RNP	X ¹	X	X
10.b.1.c	• ILS	X ¹	X	X
10.b.1.d	• Manual (raw data).		X	X
10.b.1.e	• Flight director only.		X	X
10.b.1.f	• Autopilot*only.	X ¹	X	X
10.b.2	All engines operating.	X ¹	X	X
10.b.3	Manually controlled - one or more engines inoperative.		X	X
10.b.4	Others listed on the FSTD Certificate.	X ¹	X	X
10.c	Missed approach.			
10.c.1	• All engines operating.		X	X
10.c.2	• One or more engines inoperative.		X	X
10.c.3	• Stability system failure.		X	X
10.c.4	• Others listed on the FSTD Certificate.			X
10.d.	Holding procedures		X	X
11. LANDINGS AND APPROACHES TO LANDINGS:				
11.a	Visual Approaches			
11.a.1	Normal.			X
11.a.2	Steep.			X
11.a.3	Shallow.			X
11.a.4	Crosswind.			X
11c	Landings:			
11.c.1	Normal.			
11.c.1.a	• Running.			X
11.c.1.b	• From Hover.			X
11.c.2	One or more engines inoperative.			X
11.c.3	Crosswind.			X
11.c.4	Tailwind.			X
11.c.5	Rejected Landing.			X
11.c.6	Others listed on the FSTD Certificate.			X
12. ANY FLIGHT PHASE - Normal and Abnormal Procedures :				
<i>X² - Applicable to systems installed.</i>				
12.a.1	Environmental system.	X ²	X	X
12.a.2	Anti-icing/deicing.	X ²	X	X
12.a.3	Auxiliary power-plant.	X ²	X	X
12.a.4	Communications.	X ²	X	X
12.a.5	Electrical system.	X ²	X	X
12.a.6	Fire detection and suppression.	X ²	X	X
12.a.7	Flight controls.		X	X
12.a.8	Fuel and oil systems.	X ²	X	X
12.a.9	Hydraulic system.	X ²	X	X

Table D3A – Rotorcraft Type-Specific FTD Level 5 to 7 - Functions and Subjective Tests

Entry No.	Operations Tasks	FTD Level		
		5	6	7
12.a.10	Landing gear.		X	X
12.a.11	Oxygen.	X ²	X	X
12.a.12	Pneumatic.	X ²	X	X
12.a.13	Powerplant.	X ²	X	X
12.a.14	Flight control computers.		X	X
12.a.15	Stability and control augmentation system(s).		X	X
12.a.16	Fly-by-wire controls.		X	X
12.a.17	Stabilizer.		X	X
12.a.18	Others listed on the FSTD Certificate.	X ²	X	X
12.b	Flight management and guidance system (as applicable).			
12.b.1	Airborne radar.		X	X
12.b.2	Automatic landing aids.		X	X
12.b.3	Autopilot.		X	X
12.b.4	Collision avoidance system.		X	X
12.b.5	Flight data displays.		X	X
12.b.6	Flight management computers.		X	X
12.b.7	Heads-up displays.		X	X
12.b.8	Navigation systems.		X	X
13.	Airborne Emergency procedures.			
12.c.1	Autorotation Landing			X
12.c.2	Air hazard avoidance.			X
12.c.3	Retreating blade stall recovery.			X
12.c.4	Mast bumping.			X
12.c.5	Loss of directional control.			X
12.c.6	Loss of tail rotor effectiveness.			X
12.c.7	Ditching			X
12.c.8	Emergency Evacuation			X
12.c.9	Inflight fire and smoke removal.			X
12.c.10	Others listed on the FSTD Certificate.	X ²		X
13.	ENGINE SHUTDOWN AND PARKING.			
13.a	Post-landing procedure	X	X	X
13.b	Engine and systems operation.	X	X	X
	Parking brake operation.	X	X	X
13.d	Rotor brake Operation	X	X	X
14.	INSTRUCTOR OPERATING STATION (IOS), AS APPROPRIATE.			
14.a	Power switch (es).	X	X	X
14.b	Rotorcraft conditions			
14.b.1	• Gross weight, center of gravity, fuel loading and allocation, etc.		X	X
14.b.2	• Rotorcraft systems status.		X	X
14.b.3	• Ground crew functions (e.g., ext. power).		X	X
14.c	Airports / Heliports / Rotorcraft Landing Areas			
14.c.1	• Ground crew functions (e.g., ext. power).		X	X
14.c.2	• Ground crew functions (e.g., ext. power).		X	X
14.c.3	• Preset positions (e.g., ramp, over final approach fix).		X	X
14.d	Environmental controls.			
14.d.1	• Temperature.		X	X
14.d.2	• Climate conditions (e.g., ice, rain).		X	X
14.d.3	• Wind speed and direction.		X	X
14.d.4	• Appropriate defaults for nominal flight conditions on system boot up.)		X	X

Table D3A – Rotorcraft Type-Specific FTD Level 5 to 7 - Functions and Subjective Tests				
Entry No.	Operations Tasks	FTD Level		
		5	6	7
14.e	Rotorcraft system malfunctions (insertion / deletion and clearing)		X	X
14.f	Locks, Freezes, and Repositioning		X	X
14.f .1	Preset positions (ground; air)	X		
14.g	SOUND CONTROLS - On / Off / adjustment		X	X
14.h	MOTION / CONTROL LOADING SYSTEM (As applicable) - On / Off / emergency stop	X	X	X
14.i	OBSERVER SEATS / STATIONS - Position / Adjustment / Position restraint system.	X	X	X

* "Autopilot" means attitude retention mode of operation.

Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests

Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests				
Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
Tasks training levels indicated in this table are recommendations based on subject to evaluation of systems installed in the FTD. They are meant to provide guidance to the TPAA responsible for approving air operator training programs. Final approval for credits in an approved training program will rest solely with the TPAA. (See Section 5.10 of Chapter 5 for further guidance).				
LEGEND				
PT – suitable for procedural knowledge training.				
ST – suitable for skill training related to task.				
MT – suitable for manoeuvre training & checking for the task.				
“N” – Denotes that the device is not suitable or not applicable to task.				
PREPARATION FOR FLIGHT				
Functional check (pre-flight inspection)				
• Pre-flight cockpit inspection				
• Pre-start checks				
• Programme rotorcraft automation				
• Set-up navigation aids and communications equipment				
SURFACE OPERATIONS (PRE-TAKE-OFF)				
APU/engine start and run-up				
• Normal start			N	
• Alternate start procedures			N	
• Abnormal starts and shutdowns			N	
• Rotor start/engagement and acceleration			N	
o Rotor start/engagement and acceleration		N	N	
o Rotor engagement		N	N	
• After start systems checks			N	
Taxi — Ground				
• Collective lever/cyclic friction		N	N	
• Power to taxi/cyclic input		N	N	
• Brake operation (normal, alternate, emergency)		N	N	
• Ground handling		N	N	
• Water taxi/handling (if applicable)		N	N	
• Tail/nosewheel lock operation				
• Taxi aids (e.g., moving map)				
• Pre-take-off checks			N	

Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests

Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
• Other				
Taxi — Hover/air taxi				
• Lift-off characteristics		N	N	
Hover characteristics, engine and flight instrument response				
• In ground effect (IGE)		N	N	
• Out of ground effect (OGE)		N	N	
Hover power checks				
• In ground effect (IGE)		N	N	
• Out of ground effect (OGE)		N	N	
Hover turns				
○ Spot turns		N	N	
○ Turns about the nose		N	N	
○ Turns about the tail		N	N	
• Anti-torque effect/directional control effect		N	N	
• Translating tendency		N	N	
• No wind/headwind/crosswind /tailwind hover		N	N	
• Critical azimuth		N	N	
• Air Taxi/transit/translational flight		N	N	
○ Forward		N	N	
○ Sideward		N	N	
○ Rearward		N	N	
TAKE-OFF AND DEPARTURE				
Normal				
• From ground		N	N	
• From hover				
○ CAT A and/or PC1/PC2 for all certified profiles		N	N	
○ CAT B or PC3		N	N	
• Running		N	N	
• Crosswind/tailwind		N	N	
• Maximum performance		N	N	
• MCTM		N	N	
• Confined area		N	N	
• Slope		N	N	

Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests

Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
• Obstacle clearance		N	N	
• Elevated heliport/platform/helideck/pinnacle		N	N	
• Vertical		N	N	
• Automation management				
• Transition to forward flight			N	
• Post-departure checks		N	N	
Abnormal/emergency procedures				
• Engine failure		N	N	
• Rejected take-off		N	N	
○ Over land		N	N	
○ Over water (if float equipped)		N	N	
• CAT A and/or PC1/PC2		N	N	
○ Engine failure prior to TDP		N	N	
○ Engine failure at or after TDP		N	N	
• Instrument departure			N	
• Other				
CLIMB				
Normal			N	
Obstacle clearance		N	N	
Best rate		N	N	
Best angle		N	N	
Vertical climb		N	N	
One engine inoperative		N	N	
Level-off			N	
CAT A and/or PC1/PC2 operation		N	N	Certified profiles from 300m (1000') above heliport elevation to or after LDP
Other				
CRUISE				
Performance characteristics				
• Straight and level flight			N	
• Low speed flight (not below ETL speed)		N	N	
• Accelerations and decelerations			N	
• High speed warnings			N	
• Turns				
○ Normal			N	

Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests

Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
○ Standard rates (rate ½, 1 and 2)			N	
○ Steep (30° and 45° of bank)		N	N	
○ Flight controls servo actuator transparency effects		N	N	
DESCENT AND ARRIVAL				
Normal descent			N	
Maximum rate		N	N	
Autorotative				
• Straight in		N	N	
• With turns		N	N	
• IMC		N	N	
• To landing		N	N	
• Power recovery		N	N	
Instrument arrival			N	
INSTRUMENT APPROACHES AND LANDING				
Precision approaches to DH/DA (all engines operating)				
• ILS			N	
• CAT I – Autopilot			N	
• CAT I – Manual			N	
○ With flight director			N	
○ Without flight director			N	
• CAT II				
○ Auto-coupled (3 axes)			N	
○ Auto-collective (4 axes)			N	
• DGPS/GLS			N	
• PAR			N	
• HUD/EFVS			N	
• Other				
Precision approaches OEI		N	N	
Non-precision approaches to MDA (all engines operating)				
With autopilot				
• Surveillance radar approach			N	
• ARA			N	
• NDB			N	

Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests

Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
• VOR, VOR/DME, TACA			N	
• RNAV/RNP/GNSS/RNP APCH/ RNP APCH AR/PINS			N	
• ILS LLZ (LOC), LLZ back course (or LOC-BC)			N	
• ILS offset localizer/SDF			N	
• Circling (approach prior to the visual segment)			N	
Without autopilot				
• With FD				
○ ARA			N	
○ NDB			N	
○ VOR, VOR/DME, TACA			N	
○ RNAV/RNP/GNSS/RNP APCH/ RNP APCH AR/PINS			N	
○ ILS LLZ (LOC), LLZ back course (or LOC-BC)			N	
○ ILS offset localizer/SDF			N	
○ Circling approach (prior to the visual portion)			N	
• Without FD				
○ Surveillance radar approach			N	
○ ARA			N	
○ NDB			N	
○ VOR, VOR/DME, TACA			N	
○ RNAV/RNP/GNSS/RNP APCH/ RNP APCH AR/PINS			N	
○ ILS LLZ (LOC), LLZ back course (or LOC-BC)			N	
○ ILS offset localizer/SDF			N	
○ Circling approach (prior to the visual segment)			N	
• HUD/EFVS		N	N	
Missed approach				
• All engines, manual and autopilot coupled			N	
• Engine(s) inoperative, manual and autopilot coupled			N	
• With autopilot/stability augmentation system failure			N	
Non-precision approaches OEI		N	N	
Visual approaches				Visual system required
Normal				
○ With VASIS/PAPI		N	N	

Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests

Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
○ Without VASIS/PAPI		N	N	
• Steep		N	N	
• Shallow		N	N	
• Elevated landing site		N	N	
• Helideck on ship or rig		N	N	
• Confined area		N	N	
• Crosswind/tailwind		N	N	
• Visual circling to land manoeuvre after an approach		N	N	
• Quick stop		N	N	
• Forced landing approach		N	N	
• Transition to hover		N	N	
• HUD/EFVS			N	
• Other				
Balked landing				
○ All engines operating		N	N	
○ OEI		N	N	
○ Balked rig or deck landing		N	N	
• CAT A or PC1/PC2 operation		N	N	Certified profiles from 300m (1000') above heliport elevation to or after LDP
LANDING TRANSITION/TOUCHDOWN				
From a hover		N	N	
Running		N	N	
Slope		N	N	
Crosswind/tailwind		N	N	
Elevated heliport/platform/helideck/pinnacle		N	N	
From a visual approach		N	N	
From an instrument approach		N	N	
From autorotation		N	N	
CAT A operation (PC1/PC2)				
• Landing with engine failure prior to LDP		N	N	
• Landing with engine failure at or after LDP		N	N	
ENGINE SHUTDOWN AND PARKING (INCLUDING APPLICABLE CHECKS)				
Engine and systems operation				
Parking brake operation				
Rotor disengagement and deceleration			N	

Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests

Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
Rotor brake operation			N	
Other				
ANY FLIGHT PHASE				
Air conditioning and ventilation				
Autopilot and flight director				
• Normal flight dynamics			N	
• Abnormal flight dynamics		N	N	
Stability augmentation system				
• Normal flight dynamics			N	
• Abnormal flight dynamics		N	N	
Communications				
Electrical system				
Fire and smoke detection and suppression				
Flight controls				
• Normal flight dynamics			N	
• Abnormal flight dynamics		N	N	
Flight control computers (CCH)				
• Normal flight dynamics			N	
• Abnormal flight dynamics		N	N	
Stabilizer/stabilator				
• Normal flight dynamics			N	
• Abnormal flight dynamics		N	N	
Fuel and oil				
Hydraulic				
• Normal flight dynamics				
• Abnormal flight dynamics		N	N	
Anti-icing/de-icing				
Landing gear				
• Normal operation				
• Alternate/emergency/floats operation			N	
Lighting				
Oxygen				
Pneumatic				
APU			N	
Engine				
• Normal flight dynamics			N	
• Abnormal flight dynamics		N	N	
Transmissions				
• Normal flight dynamics			N	
• Abnormal flight dynamics		N	N	

Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests

Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
Radar				
Collision/terrain avoidance systems			N	(HTAWS, EGPWS, GPWS, TCAS)
Flight data display/annunciation				
Flight management and guidance systems				
Flight director/system displays				
• Conventional			N	
• HUD (including EFVS, if applicable)			N	
Navigation systems				
Wind shear avoidance		N	N	
EFB		N	N	
Electronic checklists				
• Normal operations				
• Abnormal/emergency operations		N	N	
Voice activated systems				
Other				
Airborne procedures and malfunctions				
• Holding				
• Air hazard avoidance			N	
• Quick stop		N	N	
• Mast bumping		N	N	
• Loss of directional control		N	N	
• Loss of anti-torque effectiveness		N	N	
• Vortex ring/settling with power		N	N	
• Ground resonance		N	N	
• Autorotation		N	N	
• IMC autorotation			N	
• Inadvertent entry into IMC		N	N	
• Recovery from unusual attitudes			N	
• Partial panel		N	N	
• Rotor, airframe and engine icing		N	N	
• Ditching			N	
• Wind shear/microburst			N	
• Airborne weather radar			N	
• Engine failure - restart			N	

Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests

Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
• Other				
• Stability augmentation malfunction in flight		N	N	
• Autopilot malfunction in flight		N	N	
Engine fire				
○ On ground			N	
▪ Rotor brake fire			N	
○ In the hover		N	N	
○ Engine fire in forward flight			N	
• Engine malfunctions			N	
• Airframe fire and smoke				
○ On ground			N	
○ In the hover		N	N	
○ Airframe fire and smoke in forward flight			N	
• Engine failure before CDP/rejected take-off		N	N	
• Engine failure at or after CDP (multi-engine)		N	N	
• OEI instrument approaches and go-around		N	N	
• OEI instrument approaches and landing		N	N	
• Autorotation to engine off landing		N	N	
• Incipient vortex ring/power settling at altitude		N	N	
• Incipient vortex ring/power settling on approach		N	N	
• MGB/IGB/TRGB chip detector/oil pressure warning in		N	N	
○ the hover			N	
○ forward flight			N	
• Hydraulic failure in the hover		N	N	
• Hydraulic failure in forward flight			N	
• Hydraulic jack stall (servo transparency)		N	N	
• Instrumentation/indication failure in VMC			N	
• Instrumentation/indication failure in IMC			N	
• DC system failure			N	
• AC system failure			N	

Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests

Operations Task Recommendation	Training Level			Notes
	PT	ST	MT	
• Battery failure			N	
• Total electrical failure			N	
• Fuel transfer failure				
• Fuel supply malfunction			N	
• Landing gear malfunction			N	
• Coupled control malfunction		N	N	
• Uncoupled control malfunction		N	N	
• ECU failures		N	N	
• Other				

Table D3B– Rotorcraft – FTD Level 4 - Functions and Subjective Tests			
INSTRUCTOR OPERATING STATION (IOS)	Yes	No	NOTES
Power switch(es)			
Rotorcraft conditions:			
• Mass, CG, fuel quantity etc.			
• Rotorcraft systems status			
• Ground crew functions			
Aerodromes and landing areas:			
• Number and selection #:			
• Runway selection			
• Runway (and other) surface condition			
• Preset positions			
• Lighting controls			
Environmental controls:			
• Day/night/dusk or dawn			
• Clouds (base and top)			
• Visibility			
• Runway visual range			
• Temperature			
• Wind speed and direction			
Rotorcraft system malfunctions			
• Insertion/deletion			
• Clear/reset malfunction			
Locks, freezes, repositioning:			
• Problem freeze/release			
• Position freeze/release			
• Repositioning			
• Ground speed control			
• Remote IOS			
Sound controls			
• On/off/rheostat			
Observer stations			

Table B3C – Rotorcraft - FTD Level 7 - Class I Airport and Landing Area Models - Functions and Subjective Tests

Table B3C – Rotorcraft - FTD Level 7 - Class I Airport and Landing Area Models	
Entry No.	Class I Visual Scene Models FTD Level 7 - Functions and Subjective Tests
<i>This table specifies the minimum airport visual model content and functionality to qualify an FTD at level 7. The requirements only applies to the airport/helicopter landing area scenes required for the FTD qualification.</i>	
1. FUNCTIONAL TEST CONTENT REQUIREMENTS FOR LEVEL 7 ROTORCRAFT SIMULATORS.	
The following is the minimum airport model content requirement to satisfy visual capability tests, and provides suitable visual cues to allow completion of all functions and subjective tests described in this Table for Level 7 FTDs.	
1.a.	A minimum of one (1) representative airport and one (1) representative helicopter landing area model. The airport and the helicopter landing area may be contained within the same model. If but if this option is selected, the approach path to the airport runway(s) and the approach path to the helicopter landing area must be different. The model(s) used to meet the following requirements may be demonstrated at either a fictional or a real-world airport or rotorcraft landing area, but each must be acceptable to the sponsor's TPAA, selectable from the IOS, and listed on the FSTD Certificate.
1.b.	The fidelity of the visual scene must be sufficient for the aircrew to visually identify the airport and/or rotorcraft landing area; determine the position of the simulated rotorcraft within the visual scene; successfully accomplish take-offs, approaches, and landings; and maneuver around the airport on the ground, or hover taxi, as necessary.
1.b.1	For each of the airport/ rotorcraft landing areas described in 1.a., the FTD visual system must be able to provide at least the following:
1.b.1.a	• A night and twilight (dusk) environment.
1.b.1.b	• A daylight environment.
1.c.	Runways
1.c.1	Visible runway number.
1.c.2	Runway threshold elevations and locations must be modeled to provide sufficient correlation with rotorcraft systems (e.g., altimeter).
1.c.3	Runway surface and markings.
1.c.4	Lighting for the runway in use including runway edge and centerline.
1.c.5	Lighting, visual approach aid and approach lighting of appropriate colors.
1.c.6	Representative taxiway lights.
1.d.	Other rotorcraft landing area:
1.d.1	Standard heliport designation ("H") marking, properly sized and oriented.
1.d.2	Perimeter markings for the Touchdown and Lift-Off Area (TLOF) or the Final Approach and Takeoff Area (FATO), as appropriate.
1.d.3	Perimeter lighting for the TLOF or the FATO areas, as appropriate.
1.d.4	Appropriate markings and lighting to allow movement from the runway or helicopter landing area to another part of the landing facility.
2. VISUAL SCENE MANAGEMENT. The following is the minimum visual scene management requirements for a Level 7 FTD.	
2.a.	Runway and helicopter landing area approach lighting must fade into view appropriately in accordance with the environmental conditions set in the FTD.
2.b	The direction of strobe lights, approach lights, runway edge lights, visual landing aids, runway centerline lights, threshold lights, touchdown zone lights, and TLOF or FATO lights must be replicated.
3. VISUAL FEATURE RECOGNITION.	
The following are the minimum distances at which runway features must be visible. Distances are measured from runway threshold or a helicopter landing area to a rotorcraft aligned with the runway or helicopter	

Table B3C – Rotorcraft - FTD Level 7 - Class I Airport and Landing Area Models

Entry No.	Class I Visual Scene Models FTD Level 7 - Functions and Subjective Tests
	landing area on an extended 3° glide-slope in simulated meteorological conditions. For circling approaches, all tests apply to the runway used for the initial approach and to the runway of intended landing.
3.a.	For runways: runway definition, strobe lights, approach lights, and edge lights from 5 sm (8 km) of the threshold.
3.b.	For runways: centerline lights and taxiway definition from 3 sm (5 km).
3.c.	For runways: runway threshold lights and touchdown zone from 2 sm (3 km).
3.d.	For runways and rotorcraft landing areas: markings within range of landing lights for night/twilight scenes and the surface resolution test on daylight scenes, as required.
3.e.	For circling approaches: the runway of intended landing and associated lighting must fade into view in a non-distracting manner.
3.f.	For rotorcraft landing areas: landing direction lights and raised FATO lights from 1 sm (1.5 km).
3.g.	For rotorcraft landing areas: Flush mounted FATO lights, TOFL lights, and the lighted
3.h.	For runways: runway threshold lights and touchdown zone from 2 sm (3 km).
4. AIRPORT OR HELICOPTER LANDING AREA MODEL CONTENT. The following prescribes the minimum requirements for an airport/helicopter landing area visual model and identifies other aspects of the environment that must correspond with that model for a Level 7 FTD. For circling approaches, all tests apply to the runway used for the initial approach and to the runway of intended landing. If all runways or landing areas in a visual model used to meet the requirements of this attachment are not designated as “in use,” then the “in use” runways / landing areas must be listed on the SOQ (e.g., KORD, Rwys 9R, 14L, 22R). Models of airports or rotorcraft landing areas with more than one runway or landing area must have all significant runways or landing areas not “in-use” visually depicted for airport / runway / landing area recognition purposes. The use of white or off white light strings that identify the runway or landing area for twilight and night scenes are acceptable for this requirement; and rectangular surface depictions are acceptable for daylight scenes. A visual system’s capabilities must be balanced between providing visual models with an accurate representation of the airport and a realistic representation of the surrounding environment. Each runway or helicopter landing area designated as an “in-use” runway or area must include the following detail that is developed using airport pictures, construction drawings and maps, or other similar data, or developed in accordance with published regulatory material; however, this does not require that such models contain details that are beyond the design capability of the currently qualified visual system. Only one “primary” taxi route from parking to the runway end or rotorcraft takeoff/landing area will be required for each “in-use” runway or rotorcraft takeoff/landing area.	
4.a.	The surface and markings for each “in-use” runway or helicopter landing area must include the following:
4.a.1	For airports: runway threshold markings, runway numbers, touchdown zone markings, fixed distance markings, runway edge markings, and runway centerline stripes.
4.a.2	For helicopter landing areas: markings for standard heliport identification (“H”) and TOFL, FATO, and safety areas.
4.b.	The lighting for each “in-use” runway or helicopter landing area must include the following:
4.b.1	For airports: runway approach, threshold, edge, end, centerline (if applicable), touchdown zone (if applicable), leadoff, and visual landing aid lights or light systems for that runway.
4.b.2	For helicopter landing areas: landing direction, raised and flush FATO, TOFL, windsock lighting.
4.c.	The taxiway surface and markings associated with each “in-use” runway or helicopter landing area must include the following:
4.c.1	For airports: taxiway edge, centerline (if appropriate), runway hold lines, and ILS critical area(s).
4.c.2	For helicopter landing areas: taxiways, taxi routes, and aprons.
4.d.	The taxiway lighting associated with each “in-use” runway or helicopter landing area must include the following:
4.d.1	For airports: taxiway edge, centerline (if appropriate), runway hold lines, ILS critical areas.

Table B3C – Rotorcraft - FTD Level 7 - Class I Airport and Landing Area Models	
Entry No.	Class I Visual Scene Models FTD Level 7 - Functions and Subjective Tests
4.d.2	• For helicopter landing areas: taxiways, taxi routes, and aprons.
4.d.3	• For airports: taxiway lighting of correct color.
4.e.	Airport signage associated with each “in-use” runway or helicopter landing area must include the following:
4.e.1	• For airports: signs for runway distance remaining, intersecting runway with taxiway, and intersecting taxiway with taxiway.
4.e.2	• For helicopter landing areas: as appropriate for the model used.
4.f.	Required visual model correlation with other aspects of the airport or helicopter landing environment simulation:
4.f.1	• The airport or helicopter landing area model must be properly aligned with the navigational aids that are associated with operations at the “in-use” runway or helicopter landing area.
4.f.2	• The simulation of runway or helicopter landing area contaminants must be correlated with the displayed runway surface and lighting, if applicable.
5. CORRELATION WITH HELICOPTER AND ASSOCIATED EQUIPMENT. The following are the minimum correlation comparisons that must be made for a Level 7 FTD.	
5.a.	Visual system compatibility with aerodynamic programming.
5.b.	Visual cues to assess sink rate and depth perception during landings.
5.c.	Accurate portrayal of environment relating to FTD attitudes.
5.d.	The visual scene must correlate with integrated helicopter systems, where installed (e.g., terrain, traffic and weather avoidance systems and Head-up Guidance System (HGS)).
5.e.	Representative visual effects for each visible, own-ship, helicopter external light(s) – taxi and landing light lobes (including independent operation, if appropriate).
5.f.	The effect of rain removal devices.
6. SCENE QUALITY. The following are the minimum scene quality tests that must be conducted for a Level 7 FTD.	
6.a.	System light points must be free from distracting jitter, smearing and streaking.
6.b.	Demonstration of occulting through each channel of the system in an operational scene.
6.c.	Six discrete light step controls (0-5).
7. INSTRUCTOR CONTROLS. The following are the minimum instructor controls that must be available as indicated.	
7.a.	Environmental effects, e.g. cloud base, cloud effects, cloud density, visibility in statute miles/kilometers and RVR in feet/meters.
7.b.	Airport or helicopter landing area selection.
7.c.	Airport or helicopter landing area lighting, including variable intensity.
7.d.	Dynamic effects including ground and flight traffic.
10. An example of being able to “combine two airport models to achieve two “in-use” runways: One runway designated as the “in-use” runway in the first model of the airport, and the second runway designated as the “in-use” runway in the second model of the same airport. For example, the clearance is for the ILS approach to Runway 27, Circle to Land on Runway 18 right. Two airport visual models might be used: the first with Runway 27 designated as the “in use” runway for the approach to runway 27, and the second with Runway 18 Right designated as the “in use” runway. When the pilot breaks off the ILS approach to runway 27, the instructor may change to the second airport visual model in which runway 18 Right is designated as the “in use” runway, and the pilot would make a visual approach and landing. This process is acceptable to the FAA as long as the temporary interruption due to the visual model change is not distracting to the pilot.	
11. Sponsors are not required to provide every detail of a runway, but the detail that is provided should be correct within reasonable limits.	

Table B3D – Rotorcraft - FTD Level 7 - Class II Airport and Landing Area Models - Functions and Subjective Tests

Table B3D – Rotorcraft - FTD Level 7 - Class II Airport and Landing Area Models	
Entry No.	Class II Visual Scene Models FTD Level 7 - Functions and Subjective Tests
<i>This table specifies the minimum airport or helicopter landing area visual model content and functionality necessary to add visual models to an FTD's visual model library (i.e., beyond those necessary for qualification at the stated level) without the necessity of further involvement of the MSP or TPAA.</i>	
1. AIRPORT OR LANDING AREA MODEL MANAGEMENT.	
The following is the minimum visual scene management requirements for simulators at Levels 7.	
1.a.	The installation and direction of the following lights must be replicated for the "in-use" surface:
1.a.1	• For "in-use" runways: strobe lights, approach lights, runway edge lights, visual landing aids, runway centerline lights, threshold lights, and touchdown zone lights.
1.a.2	• For "in-use" rotorcraft landing areas: ground level TLOF perimeter lights, elevated TLOF perimeter lights (if applicable), Optional TLOF lights (if applicable), ground FATO perimeter lights, elevated TLOF lights (if applicable), and landing direction lights.
2. VISUAL FEATURE RECOGNITION.	
The following are the minimum distances at which runway or landing area features must be visible for simulators at Level B, C, and D. Distances are measured from runway threshold or a helicopter landing area to an aircraft aligned with the runway or helicopter landing area on a 3° glide-slope from the aircraft to the touchdown point, in simulated meteorological conditions. For circling approaches, all tests apply to the runway used for the initial approach and to the runway of intended landing.	
2.a.	For Runways:
2.a.1	• Strobe lights, approach lights, and edge lights from 5 sm (8 km) of the threshold.
2.a.2	• Centerline lights and taxiway definition from 3 sm (5 km).
2.a.3	• Visual Approach Aid lights (VASI or PAPI) from 3 sm (5 km) of the threshold.
2.a.4	• Visual Approach Aid lights (VASI or PAPI) from 5 sm (8 km) of the threshold.
2.a.5	• Threshold lights and touchdown zone lights from 2 sm (3 km).
2.a.6	• Markings within range of landing lights for night/twilight (dusk) scenes and as required by the surface resolution test on daylight scenes.
2.a.7	• For circling approaches, the runway of intended landing and associated lighting must fade into view in a non-distracting manner.
2.b.	For Helicopter landing areas:
2.b.1	Landing direction lights and raised FATO lights from 1 sm (1.5 km).
2.b.2	Flush mounted FATO lights, TOFL lights, and the lighted windsock from 0.5 sm (750 m)
2.b.3	Hover taxiway lighting (yellow/blue/yellow cylinders) from TOFL area.
2.b.4	Markings within range of landing lights for night/twilight (dusk) scenes and as required by the surface resolution test on daylight scenes.
3. AIRPORT OR HELICOPTER LANDING AREA MODEL CONTENT.	
The following prescribes the minimum requirements for what must be provided in an airport visual model and identifies other aspects of the airport environment that must correspond with that model for simulators at Level B, C, and D. The detail must be developed using airport pictures, construction drawings and maps, or other similar data, or developed in accordance with published regulatory material; however, this does not require that airport or helicopter landing area models contain details that are beyond the designed capability of the currently qualified visual system. For circling approaches, all requirements of this section apply to the runway used for the initial approach and to the runway of intended landing. Only one "primary" taxi route from parking to the runway end or rotorcraft takeoff/landing area will be required for each "in-use" runway or rotorcraft takeoff/landing area.	
3.a.	The surface and markings for each "in-use" runway or helicopter landing area must include the following:
3.a.1	• For airports: runway threshold markings, runway numbers, touchdown zone markings, fixed distance markings, runway edge markings, and runway centerline stripes.

Table B3D – Rotorcraft - FTD Level 7 - Class II Airport and Landing Area Models	
Entry No.	Class II Visual Scene Models FTD Level 7 - Functions and Subjective Tests
3.a.2	• For helicopter landing areas: Standard heliport marking (“H”), TOFL, FATO, and safety areas.
3.b.	The lighting for each “in-use” runway or helicopter landing area must include the following:
3.b.1	• For airports: runway approach, threshold, edge, end, centerline (if applicable), touchdown zone (if applicable), leadoff, and visual landing aid lights or light systems for that runway.
3.b.2	• For helicopter landing areas: landing direction, raised and flush FATO, TOFL, windsock lighting.
3.c.	The taxiway surface and markings associated with each “in-use” runway or helicopter landing area must include the following:
3.c.1	• For airports: taxiway edge, centerline (if appropriate), runway hold lines, and ILS critical area(s).
3.c.2	• For helicopter landing areas: taxiways, taxi routes, and aprons.
3.d.	The taxiway lighting associated with each “in-use” runway or helicopter landing area must include the following:
3.d.1	• For airports: runway edge, centerline (if appropriate), runway hold lines, ILS critical areas.
3.d.2	• For rotorcraft landing areas: taxiways, taxi routes, and aprons.
4. REQUIRED VISUAL MODEL CORRELATION WITH OTHER ASPECTS OF THE AIRPORT ENVIRONMENT SIMULATION.	
The following are the minimum visual model correlation tests that must be conducted for Level 7 FTD.	
4.a.	The airport model must be properly aligned with the navigational aids that are associated with operations at the “in-use” runway.
4.b.	Slopes in runways, taxiways, and ramp areas, if depicted in the visual scene, must not cause distracting or unrealistic effects.
5. CORRELATION WITH ROTORCRAFT AND ASSOCIATED EQUIPMENT. The following are the minimum visual model correlation tests that must be conducted for Level 7 FTD.	
5.a.	Visual system compatibility with aerodynamic programming.
5.b.	Accurate portrayal of environment relating to flight simulator attitudes.
5.c.	Visual cues to assess sink rate and depth perception during landings.
6. SCENE QUALITY. The following are the minimum scene quality tests that must be conducted.	
6.a.	Light points free from distracting jitter, smearing or streaking.
6.b.	Surfaces and textural cues free from apparent and distracting quantization (aliasing).
7. INSTRUCTOR CONTROLS: The following are the minimum instructor controls that must be available.	
7.a.	Environmental effects, e.g., cloud base (if used), cloud effects, cloud density, visibility in statute miles/kilometers and RVR in feet/meters.
7.b.	Airport/Heliport selection.
7.c.	Airport lighting including variable intensity.
7.d.	Dynamic effects including ground and flight traffic.
8. Sponsors are not required to provide every detail of a runway or rotorcraft landing area, but the detail that is provided must be correct within the capabilities of the system.	

Chapter 6 - Non-Type-Specific Flight Training Device - Qualification Performance Standards

6.1 Overview

- 6.1.1 This chapter describes the qualification performance standards (QPS) for **aeroplane** and **rotorcraft** Flight Training Devices (FTD) (Level 1 and 2). Wherever the term “**aircraft**” is used, it refers to both aeroplanes and rotorcraft. The performance standards were derived from ICAO Document 9625 Edition 3 Volume 1 and 2, with some modifications based on an analysis of single and multi-engine; multi-crew coordination and Instrument Procedures Check requirements from and CAR Part IV training program requirements. The technical requirements and evaluation criteria specific to aeroplane and rotorcraft FSTDs are presented in the following appendices and tables:

A. AEROPLANE - NON-TYPE SPECIFIC FTD - QPS

- a. Appendix E1 – Aeroplane FTD – General Simulator Requirements
- b. Appendix E2 – Aeroplane FTD – Objective Test Requirements
- c. Appendix E3 – Aeroplane FTD – Simulator Subjective Evaluations

B. ROTORCRAFT - NON-TYPE SPECIFIC FTD - QPS

- d. Appendix F1 – Rotorcraft FTD – General Simulator Requirements
- e. Appendix F2 – Rotorcraft FTD – Objective Test Requirements
- f. Appendix F3 – Rotorcraft FTD – Simulator Subjective Evaluations

ATTACHMENTS:

- g. **Attachment 6.1 - Sample FTD Certificate for Regional Authorities**
- h. **Attachment 6.2 - Non-Type-Specific FTD Qualification Profile**

6.2 Roles and Responsibilities.

- 6.2.1 The NSEP is responsible for ensuring that all FSTDs used for pilot training and checking are evaluated in accordance with the requirements of CAR 606.03. To provide responsive and efficient service delivery and oversight, the MSP may delegate the conduct of initial evaluations of non-type-specific FTDs to Regional Authorities provided that:
- a. The FTD product or series produced by a particular manufacturer has been previously approved in by the NSEP and operated in Canada;
 - b. The QTG does not present automated test results;
 - c. The sponsor is not requesting additional qualifications that are not covered by the QPS in this chapter.
- 6.2.2 The MSP may delegate recurrent evaluations of Level 1 and 2 FTDs to Regional Authorities after the NSEP completes the initial evaluation and follow-up corrective action. The Regional Authority may request the NSEP to participate in the first recurrent if knowledge transfer is required (particularly in the case of automatic testing).
- 6.2.3 The Regional Authority assuming oversight of a Level 1 or 2 FTD is responsible for:
- a. verifying FTD sponsor eligibility;
 - b. conducting initial evaluations as delegated;
 - c. conducting recurrent evaluations in accordance with CAR 606.03;
 - d. tracking and ensuring corrective action of discrepancies noted during the evaluations;
 - e. Issue certificate

- 1) TCID number,
 - 2) FTD Sponsor,
 - 3) FTD location,
 - 4) manufacturer/model,
 - 5) aircraft class/set simulated,
 - 6) serial number,
 - 7) issuing authority (Region)
 - 8) FTD Level and special qualifications,
 - 9) QPS used
 - 10) Date of issue and expiry date.
 - 11) Qualification Profile (as page 2).
- f. Maintaining a record of FTD certificates, TCID numbers issued; evaluation reports and associated qualification documents.

Note: Sample certificate and qualification profile form is shown at attachments 6.1 and 6.2 (RDIMS #13698343).

Note: TCID numbers issued by Regional Authorities are 4 digits, where the first digit represents the Region as follows: Atlantic Region – 2xxx; Quebec Region - 3xxx; Ontario Region - 4xxx; Prairie Northern Region – 5xxx; Pacific Region – 6xxx. TCID numbers 0 to 1999 are reserved for NSEP use.

6.3 General Description of Non-Type-Specific FTDs

6.3.1 Unlike type-specific FTDs, non-type-specific FTDs are intended to be representative of a class or set of aircrafts. The expression “generic device” has traditionally been used to designate such non-type-specific devices; however, in this chapter, the expression “generic device” has been replaced by “non-type-specific” to preclude confusion with the simulation feature fidelity as defined by the Table 6.2-1 below.

Note: “Class” in relation to the classification of aircrafts, means aircrafts having similar operating characteristics to single-engine aircrafts, multi-engine aircrafts, centre-line thrust aircrafts, land aircrafts or sea aircrafts.

Note: “Set of Aircraft” is a group or series of aircraft group that share similar handling and operating characteristics, similar operating envelopes, and have the same number and type of engines or power-plants.

FIDELITY	AIRCRAFT SIMULATION	SOUND, MOTION AND VISUAL CUEING	ENVIRONMENT SIMULATION
Generic	Not specific to aircraft model, type or variant.	Generic to an aircraft of its class. Simple modelling of key basic cueing features. For <i>visual cueing only</i> : 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 aircraft of its class, e.g., to engine turbo-prop aircraft. It does not have to be type specific.	For <i>sound and motion cueing only</i> : Replicates a specific aircraft in set of aircrafts to the maximum extent possible. For <i>visual cueing only</i> : Representative of the real world visual environment and perspective.	Representative of the real world environment.

Specific	Replicates the specific aeroplane model, type or variant.	Applicable to <i>visual cueing only</i> : replicates the real world visual environment and (infinity) perspective.	Replicates the real world environment as far as possible for any specific location.

6.4 Non-Type-Specific FTD Levels

6.4.1 The Non-Type-Specific FTD levels were developed to provide guidance and minimum FTD requirements to Flight Training Units (FTUs) who seek approval to use a lower cost FTDs in approved training programs for single and multi-engine licensing, multi crew coordination (MCC) (for aeroplanes only), and Instrument Proficiency Checks (IPC) (for aeroplanes only). **These devices are not authorized for any experience, training or checking credits in type-specific approved training programs.** MCC and IPC training or checking on FTDs simulating aeroplanes that require a type-rating may only be conducted on type-specific FTDs (See para 6.4.3 for eligible FTDs)

6.4.2 There are two basic non-type-specific FTD configuration:

- a. **Level 1** - A level 1 FTD is the lowest fidelity device and may have a “generic” cockpit design. The device does not require a visual system or active force-feedback flight controls. It will support basic instrument procedural training, and may provide experience credit for 5 hours pursuant to CAR 421.26(4)(a) pending evaluation.
- b. **Level 2** – A Level 2 FTD, is a device that represents a “designated” class and set of aircraft. The device requires active force-feedback flight controls and requires a visual system that meets the minimum requirements in Tables E1A or F1A as applicable. It will support basic instrument procedure training and may provide experience credit for 10 hours pursuant to CAR 421.30(4)(a)(ii)(A)(III) pending evaluation.

6.4.3 An aeroplane FTD may qualify for instrument proficiency checks (IPC) and/or for multi-crew coordination (MCC) training in an ATP(A) program if the device meets the following criteria.

- a. MCC Qualification. An FTD may qualify as a Multi-Crew Coordination FTD provided that it:
 - 1) Meets the criteria objective and subjective test criteria for an FTD Level 2, 5, 6, or 7; and
 - 2) Meets or exceeds the criteria outlined in Appendices E for the MCC qualification; and
 - 3) Fully supports the procedural and operational performance tasks required in the TC approved training program for ATP(A), per CAR as amended.
- b. IPC Qualification. An FTD will qualify as a platform to conduct Instrument Proficiency Checks (IPC) provided that it:
 - 1) Meets the criteria objective and subjective test criteria for an FTD Level 2, 5, 6, or 7;
 - 2) Meets or exceeds the criteria outlined in Appendices E for the IPC qualification; and
 - 3) Fully supports the procedural and operational performance tasks IPC in the Advisory Circular AC-401-004 as amended to conduct an IPC.

Note: An aeroplane FTD granted an additional MCC or IPC qualification will be designated on the FSTD certificate as Level #-MCC. (i.e. Level 5-MCC; Level 2-IPC; Level 6-MCC/IPC)

Note: When an FTD Level 2-IPC is used in an approved instrument training program, the FTD’s Class/Set should match that of the aeroplanes used in that program.

Note: When an FTD Level 2-MCC is used in an approved multi-crew coordination training program, the FTD’s Class/Set should match that of the aeroplanes used in that program.

Note: The term “**Designated**” is used when a feature or requirement must be specifically identified by the sponsor prior to the initial evaluation or update evaluation.

- 6.4.4 Detailed standards and tests for the various levels of FTDs are fully defined in Appendices E for aeroplanes and Appendices F for rotorcraft.

6.5 General Design Standards

- 6.5.1 To avoid any delays in the design, build, acceptance, or qualification process, the sponsor should engage in early discussions with the TPAA and Approving Authority to broadly agree on the “*designated aircraft configuration*” and any additional qualifications (MCC or IPC) intended.
- 6.5.2 **Cockpit/Flight Deck Configuration.** The Sponsor should choose a configuration that sensibly represents the aircrafts likely to be used in the approved training program. To ensure a good training environment, the cockpit/flight deck should be located in a training environment that minimizes any distractions.
- a. **Level 1.** The cockpit/flight deck must sufficiently represent a class of aircraft to support approved use. The cockpit/flight deck may be open or enclosed. The appearance, arrangement, operation, and function of physical switches and other required controls must be realistically placed. The instrument panel of an **aeroplane FTD** must include at least the following:
 - 1) Master/battery;
 - 2) Magnetos for each engine (as applicable);
 - 3) Alternators for each engine;
 - 4) Fuel boost pumps for each engine;
 - 5) Avionics master;
 - 6) Pitot heat; and
 - 7) Rotating beacon/strobe, navigation, taxi, and landing lights.
 - b. **Level 2.** The cockpit/flight deck must be representative of a set of aircrafts or the aircraft itself to support approved use. The cockpit/flight deck must be sufficiently enclosed to minimize distractions. The physical arrangement, appearance, and operation of controls, instruments, and switches should model at least one aircraft in the family of aircraft represented as closely as practicable.
- 6.5.3 **Cockpit/Flight Deck Components.** Physical flight and aircraft system controls must be recognizable as to their function and how they are to be manipulated solely from their appearance.
- a. Physical flight and aircraft system controls must not use interfaces such as a keyboard, mouse, or gaming joystick to control the represented aircraft in simulated flight.
 - b. Components used within the cockpit/flight deck area do not need to be aircraft parts; however, any parts used should be representative of typical training aircrafts and should be robust enough to endure the training tasks.
 - c. The use of simple flat display technology-based representations and touch-screen controls to represent objects other than basic push-button types of controls will not be acceptable. The training tasks envisaged for these devices 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 aircraft instrument panel may be acceptable.
- ## 6.6 Data package
- 6.6.1 The data for the aerodynamics model, flight controls and engines used in Level 1 or 2 FTDs must be based on sound engineering principles and substantiated in the form of a “Reference Data” engineering report (RDR). The RDR shall show that the proposed validation data are representative of the aircraft or the class of aircrafts modelled. This report may include flight test data, manufacturer’s design data, information from the aircraft 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 FTD manufacturer to substantiate the proposed model.

- 6.6.2 Generic or representative data may be derived from a specific aircraft within the class of aircrafts simulated, or it may be based on information from several aircrafts within a group of aircrafts that reflect the performance of the “designated aircraft configuration”.
- 6.6.3 With the concurrence of the NSEP, the data may be in the form of a manufacturer’s previously approved set of validation data for the applicable FTD. The sponsor should submit the intended validation data together with a substantiation report to the NSEP for review and approval prior to procurement or the commencement of the manufacturing or procurement process. Once the set of data for a specific FTD has been accepted and approved by the NSEP, it will become the validation data that will be used as reference for subsequent recurrent evaluations with the application of the stated tolerances.
- 6.6.4 **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 aircraft or class of aircrafts being simulated. The models should be continuous and vary sensibly throughout the required training flight envelope. The following principles apply:
- Additional data to refine the non-type-specific model can be obtained from many sources, such as aircraft design data, flight and maintenance manuals, observations on the ground and in the air, 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).
 - Data gathering should take place at representative masses and centres of gravity. Development of such a data package including justification and the rationale for the design and intended performance, the measurement methods and recorded parameters (e.g. mass, CG, atmospheric conditions) should be carefully documented and available for inspection by the NSEP as part of the qualification process.
- 6.6.5 **Flight Controls.** There can be a strong interaction between the flight control forces and the effects of both the engines and the aerodynamic configuration and will reflect the fidelity and credits offered to the FTD:
- Level 1** FTDs only require “generic” fidelity level flight controls, which may be achieved with a passive force cueing system utilizing springs. The evaluator will assess the fidelity of the flight controls during the initial and recurrent evaluations. Qualification will not be awarded if the flight controls manifest any characteristics that would result in negative training.
 - Level 2** FTDs require “representative” fidelity level flight controls, which will require an active force feedback cueing system that allows flight controls forces to vary with position as well as aircraft configuration (speed, flaps, trim).

6.7 Visual System

- 6.7.1 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”.
- 6.7.2 Collimated visual optics are not required for non-type-specific FTDs since no training credits for landing are available. A single channel direct viewing system is acceptable for level 2. For MCC and IPC additional qualifications, the visual FOV must be as per Appendix E2 (applicable to aeroplanes FTDs only).
- 6.7.3 Where the device does not simulate a particular aircraft type, the design of the out-of-cockpit/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 aircraft deviates from the

normal approach path, undue loss of visual reference should not occur during the subsequent correction.

6.8 Transport Delay

- 6.8.1 For a non-type-specific device, a transport delay test may be used to demonstrate that the FSTD system does not exceed the permissible delay. However, for such a device using simple models, a Statement of Compliance (SOC) may be acceptable in lieu of a test. The SOC must contain a system block diagram that support a description of the cumulative latency or transport delay from control input to instrument, visual and motion system response as applicable. The SOC should also describe the method of determining the transport delay.
- 6.8.2 The maximum permissible transport delays is 300 milliseconds for aeroplanes and 120 milliseconds for rotorcraft. A test may be required during the initial evaluation to verify the SOC if the calculated transport delay is close to the maximum permissible value.

6.9 Testing/Evaluation

- 6.9.1 To ensure that any device meets its design criteria initially and periodically throughout its life, a system of objective and subjective testing will be used.
- 6.9.2 The validation tests specified in Appendix E2 for aeroplanes and Appendix F2 for rotorcrafts will be flown by a suitably skilled person and the results recorded manually.
- 6.9.3 **Automatic Recording and Testing.** The MSP must be notified if a sponsor wishes to use automatic recording and testing for validation tests. In such a case, the QTG review will be conducted by the NSEP. Based on the complexity of the QTG and the results of the QTG review, the MSP will decide whether it is appropriate to retain NSEP oversight of the device or to delegate oversight to the Regional Authority.
- 6.9.4 The tolerances specified are designed to ensure that the device meets its original target criteria year after year. It is therefore important that such target data are carefully derived and values are accepted by the NSEP or Regional Authority in advance of the initial evaluation (QTG review). Unlike the target parameters stipulated for type-specific devices, those stated for non-type-specific FSTDs are primarily intended to ensure repeatability during the life of the FSTD and in particular at each recurrent regulatory inspection. For initial qualification, the device should meet its design criteria within the listed tolerances; however, the evaluator may approve reasonably altered target values if they do not adversely affect the performance of the FTD or the quality of training and the results are repeatable.
- 6.9.5 A number of tests within the QTG have had their tolerances reduced to “Correct Trend and Magnitude” (CT&M) thereby avoiding the need for specific validation data. The use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. For such tests, the performance of the FSTD should be appropriate and representative of the simulated aircraft and should under no circumstances exhibit negative characteristics. Where CT&M is used as a tolerance, it is strongly recommended that a simple, reliable, and repeatable test method be designed to establish a baseline result approved during the initial evaluation. This will be provide a means of avoid or resolving any divergent subjective opinions during recurrent evaluations.
- 6.9.6 **Longitudinal change force tests.** For Level 1 and 2 aeroplane FTDs, 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. These tests should be conducted in the following way:
- Trim the aeroplane in straight and level flight in the most suitable configuration;
 - Initiate the configuration change (power, flap or gear change);
 - Maintain the airspeed constant using the pitch control (or as an alternate procedure, maintain the altitude of the original trimmed conditions); and
 - Measure the required pitch control force change.

Note: If automatic testing is used, a change dynamics test is acceptable.

- 6.9.7 The subjective tests listed in Appendix E (aeroplanes) and F (rotorcraft) must be flown by a suitably qualified and experienced pilot.

6.10 Initial (and Upgrade) Qualification Requirements

- 6.10.1 In order to be qualified at a particular qualification level, the FTD must:
- Meet the general requirements at Appendix E1 for aeroplanes, or Appendix F1 for rotorcrafts;
 - Meet the objective testing requirements at Appendix E2 for aeroplanes, or Appendix F2 for rotorcrafts; and
 - Satisfactorily accomplish the subjective tests at Appendix E3 for aeroplanes, or Appendix F3 for rotorcrafts.
- 6.10.2 Sponsors applying for an initial evaluation must follow the procedures at Section 6.11 of this chapter. The evaluating agency must be in receipt of the following prior to conducting an evaluation:
- A statement that the FTD meets all provisions of the QPS. The Sponsor's application must also:
 - identify the class, set of aircraft or aircraft type simulated and any additional qualifications requested (i.e. IPC or MCC); and
 - Designate airport navigation and visual scenes, and operational systems as required by the QPS for the level and additional qualifications requested.
 - Unless otherwise authorized, the sponsor must send a letter of compliance to the MSP or Regional Authority (as described in paragraph 6.11.1c of this chapter) no later than 5 business days prior to the scheduled.
 - A QTG, acceptable to the MSP, that includes all of the following where required by the QPS:
 - Objective data obtained from aircraft testing or another approved source.
 - Objective test results obtained from the performance of the FTD.
 - Result of FTD subjective tests.
 - A description of the equipment necessary to perform the evaluation for initial qualification and the continuing qualification evaluations.
 - Unless otherwise approved by the MSP, the sponsor's QTG submission must include results of all required tests conducted at the sponsor's training facility after the FTD is assembled with systems and sub-systems functional and operating in an interactive manner.
- 6.10.3 During the initial (or upgrade) qualification evaluation, the sponsor must provide a person to assist with the evaluation who is a user of the device (e.g., a qualified pilot or instructor pilot with flight time experience in that aircraft) and knowledgeable about the operation of the aircraft and the FTD.

6.11 Application for Initial or Upgrade Evaluations.

- 6.11.1 The application process for an initial or upgrade qualification evaluation for a non-type-specific FTD will be administered according to the following steps:
- Letter of Intent.** For each FSTD, the sponsor must submit a "letter of intent" requesting an initial qualification evaluation to their Regional Authority no later than 120 days prior to the evaluation date requested. The letter will include:
 - A description of the FSTD;
 - The anticipated qualification level of the FSTD;
 - The make, model, and series of aircraft simulated; and any other pertinent information; and

- 4) Any additional information that may affect the scope of the evaluation (i.e. FSTD relocation, sponsorship change, restoration after voluntary suspension etc.)

Note: To avoid any qualification delays, the sponsor should contact the MSP as early as possible to coordinate a review and acceptance of the validation data package.

- b. **Regional Authority's Response.** The Regional Authority will liaise with the MSP to determine the most appropriate evaluation agency (NSEP or Regional Authority). The designated evaluating agency will reply to the letter of intent within 15 business days with the following information;
 - 1) Tentative dates for the initial evaluation;
 - 2) The date the sponsor must submit the QTG if applicable;
 - 3) An attached "qualification profile" form to be completed and returned with the QTG submission.
 - 4) Any special equipment and qualified personnel needed to accomplish or assist in the accomplishment of tests during initial qualification.
- c. **QTG Review.** The Sponsor will submit the QTG and the Reference Data Report (RDR) in a form and manner described in this chapter. The evaluating agency will review the QTG and forward comments and questions resulting from the review to the Sponsor for their response. Depending on the results of the review, the designated evaluating agency will confirm or postpone the evaluation date. The sponsor will provide a response to the QTG review comments no later than 5 working days before the evaluation date.
- d. **Letter of Compliance.** The Sponsor will submit a "letter of compliance" signed by the management representative no later than 5 working days before the evaluation confirming that:
 - 1) Qualified pilot(s), after having flown all of the applicable subjective evaluation in the applicable QPS appendix tests (Table E1B for aeroplane FTDs) relevant to the qualification level of the FSTD, have determined that the performance and handling qualities of the FTD represent those of the class or set of aircraft within the normal operating envelope. Exceptions, if any, must be noted. The name of the pilot(s) making this determination must be identified on the letter of compliance. Exceptions, if any, must be noted.
 - 2) Qualified pilot(s) or person(s) trained on simulator systems/sub-systems and trained on the operation of the simulated aircraft systems, after having exercised the operation of the FTD and the pertinent functions available through the Instructor Operating Station(s), have determined that the FTD cockpit configuration, systems, and sub-systems (including the simulated aircraft systems) functionally represent those in the aircraft class or set of aircraft. The name of the person(s) making this determination must be available to the MSP upon request. Exceptions, if any, must be noted.
- e. When the FSTD passes an evaluation for initial qualification, the MSP issues a Qualification Certificate as described at paragraph 6.2.3 of this chapter.

6.11.2 After the NSEP completes the evaluation for initial qualification, the sponsor must update the Qualification Test Guide (QTG), with the results of the TC-witnessed tests as determined by the evaluator..

6.11.3 Upon issuance of the Qualification Certificate the updated QTG becomes the Master Qualification Test Guide (MQTG). The MQTG must be made available to the Regional Authority or NSEP upon request.

6.12 Qualification Test Guide (QTG)

6.12.1 The sponsor must submit the QTG to the NSEP or delegated Regional Authority for review and approval, and must include:

- a. A QTG cover page with sponsor and TC approval signature blocks;
- b. An FTD information page that provides the information listed in this. For convertible FTDs, the sponsor must submit a separate page for each configuration of the FTD;

- 1) The sponsor's FTD identification number or code.
 - 2) The aircraft model and series being simulated.
 - 3) The reference to the data record document.
 - 4) The source of the basic aerodynamic model and the aerodynamic coefficient data used to modify the basic model.
 - 5) The engine model(s) (class)
 - 6) The flight control configuration (reference aircraft model).
 - 7) The flight management system identification and revision level.
 - 8) The FTD model and manufacturer.
 - 9) The date of FTD manufacture.
 - 10) The FTD computer identification.
 - 11) The visual system model and manufacturer, including display type.
 - 12) The motion system type and manufacturer, including degrees of freedom.
- c. A Table of Contents.
- d. A log of revisions and a list of effective pages.
- e. List of all relevant data references.
- f. A glossary of terms and symbols used (including sign conventions and units).
- g. Statements of compliance and capability (SOCs) as required by the QPS.
- h. Recording procedures or equipment required to accomplish the objective tests if applicable.
- i. The following information for each objective test required in Appendix E2, Table E2A (aeroplanes) or Appendix F2, Table F2A (rotorcraft) as applicable:
- 1) Name of the test.
 - 2) Objective of the test.
 - 3) Tolerances parameters and flight conditions.
 - 4) Pertinent and complete Manual test procedures. (Including a list of all relevant parameters driven or constrained during the manually test setup).
 - 5) A means of comparing the FTD test results to the reference data or targets.
 - 6) Other information as necessary, to assist in the evaluation or interpretation of the test results.
- j. For FTDs using Auto-testing utilities, the following information in addition to para i (above) must be included for each objective test:
- k. Initial conditions.
- l. Automatic test procedures (if applicable).
- m. Method for evaluating FTD objective test results.
- n. A list of all relevant parameters driven or constrained during the automatically conducted test(s).
- o. Tolerances for relevant parameters.
- p. Source of Validation Data (document and page number).
- q. Copy of the Validation Data (if located in a separate binder, a cross reference for the identification and page number for pertinent data location must be provided).
- r. Simulator Objective Test Results as obtained by the sponsor. Each test result must reflect the date completed and must be clearly labeled as a product of the device being tested.

- 6.12.2 TC considers convertible FTDs as a separate FTD for each converted configuration. If a sponsor seeks qualification for two or more models of an aircraft type using a convertible FTD, the sponsor must submit a QTG for each aircraft model, or a QTG for the first aircraft model and a supplement to that QTG for each additional aircraft model. The evaluating agency will conduct a separate evaluation on each aircraft model and issue the sponsor a separate TCID / certificate for each model that satisfactorily meets evaluation criteria.
- 6.12.3 The following describes the acceptable form and manner of presentation of objective test results in the QTG:
- The sponsor's FTD test results must be recorded and presented in a manner that allows easy comparison of the FTD test results to the validation data or targets.
 - Tests results must be labeled using terminology common to aircraft parameters as opposed to computer software identifications.
 - Validation data documents included in a QTG may be photographically reduced only if such reduction will not alter the graphic scaling or cause difficulties in scale interpretation or resolution.
 - Scaling on graphical presentations must provide the resolution necessary to evaluate the parameters shown in Appendix E2, Table E2A for aeroplanes, or Appendix F2, Table F2A for rotorcrafts.
 - For auto-tests that involve time histories, data sheets (or transparencies thereof) and FTD test results must be clearly marked with appropriate reference points to ensure an accurate comparison between the FTD and the aircraft with respect to time. Time histories recorded via a line printer are to be clearly identified for cross plotting on the aircraft data. Over-plots must not obscure the reference data.
- 6.12.4 The sponsor must maintain a copy of the MQTG at the FTD location.

Note: A sample QTG for Level 1 and 2 FTDs can be found in TP13799 - Qualification Test Guide – CAR Part IV Flight Training Devices.

6.13 Notification of FTD Modifications and updates.

- 6.13.1 The sponsor must notify the Regional Authority in writing at least 21 days prior to making a modification to a non-type-specific FTD. For the purposes of this manual, an FSTD is said to have been modified when:
- Equipment or devices intended to simulate aircraft appliances are added to or removed from the FSTD, which change the MQTG or the Qualification Certificate issued by the Minister; or
 - Changes are made to either software or hardware that;
 - are intended to impact flight or ground dynamics;
 - that impact performance or handling characteristics of the FSTD (including motion, visual, control loading, or sound systems for those FSTD levels requiring sound tests and measurements); or
 - require an amendment to the MQTG.

Note: Routine software or hardware changes, or changes to the MQTG which do not affect required objective testing results or validation data approved during the initial evaluation of the FSTD are not considered modifications.

- 6.13.2 **Notification and approval process.** The notification and approval process for an update or modification is as follows:
- Letter of Intent.** For each FTD, the sponsor will submit a "letter of intent" to the Regional Authority that:
 - Provides a description of the modification or update;

- 2) Identifies any procedural, functional or physical change to the FSTD that may affect pilot training and checking;
 - 3) Identifies impact flight or ground dynamics; changes are made that impact performance or handling characteristics of the FTD;
 - 4) Identifies any required changes to the MQTG; and
 - 5) Provides a date when the modification or update would be available for evaluation.
- b. **Regional Authority Response.** The regional office will reply to the letter of intent within 5 business days with the following;
- 1) Whether an update evaluation is required,
 - 2) Tentative date and scope of the update evaluation if required,
 - 3) Any special equipment and qualified personnel needed to accomplish or assist in the accomplishment of tests during the update evaluation, and
 - 4) Any additional requirements for approval if an update evaluation is deemed unnecessary.

Note: Depending on the complexity and impact on training, the MSP may approve a modification based on a letter of compliance from the sponsor.

- c. **Letter of Compliance.** The Sponsor will submit a “letter of compliance” signed by the management representative no later than 5 working days before a modification is implemented or evaluated confirming that:
- 1) Qualified pilot(s), after having flown the FTD, have determined that the performance and handling qualities represent those of the class or set of aircraft within the normal operating envelope. Exceptions, if any, must be noted. The name of the pilot(s) making this determination must be identified on the letter of compliance. Exceptions, if any, must be noted.
 - 2) Qualified pilot(s) or person(s) trained on simulator systems/sub-systems and trained on the operation of the simulated aircraft systems, after having exercised the operation of the FTD and the affected functions through the Instructor Operating Station(s), have determined that all affected systems, and sub-systems (including the simulated aircraft systems) functionally represent those in the aircraft class or set of aircraft. The name of the person(s) making this determination must be available to the MSP upon request. Exceptions, if any, must be noted.

6.13.3 **Approval.** The Regional Authority will approve the use of a modification when:

- 1) The FTD successfully passes a special evaluation; or
- 2) The Regional Authority has notified the sponsor that the letter of compliance has been accepted in lieu of an evaluation.; and
- 3) The Qualification Certificate has been appropriately amended to reflect any changes to the FTD.

6.14 Conduct of Initial and Upgrade Evaluations

6.14.1 The Regional Authority may only evaluate non-type-specific FTDs for sponsors holding a TC certificate as a Flight Training Unit. The NSEP will evaluate all type-specific FTDs.

6.14.2 The evaluator will assess each FTD configuration as completely as possible. To ensure a thorough and uniform evaluation, each FTD will be evaluated against the general simulator requirements in Appendix E1 or F1, the objective tests listed in Appendix E2 (aeroplanes) or F2 (rotorcraft), and the subjective tests listed in Appendix E3 (aeroplanes) or F3 (rotorcraft), as applicable. The evaluations will include, but not necessarily be limited to the following:

- a. Aircraft responses, including longitudinal and lateral-directional control responses (see Appendix E2 (aeroplanes) or F2 (rotorcraft) as applicable);

- b. Performance in authorized portions of the simulated aircraft's operating envelope, to include tasks evaluated by the MSP in the areas of surface operations, takeoff, climb, cruise, descent, approach, and landing as well as abnormal and emergency operations (see Appendix E2 (aeroplanes) or F2 (rotorcraft));
 - c. Control checks (see Appendix E1 and E2 (aeroplanes) or Appendix F1 and F2 (rotorcraft) as applicable);
 - d. Flight deck configuration (see Appendix E1 (aeroplanes) or F1 (rotorcraft) as applicable);
 - e. Pilot, flight engineer, and instructor station functions checks (see Appendix E1 and E3 (aeroplanes) or Appendix F1 and F3 (rotorcraft) as applicable);
 - f. Aircraft systems and sub-systems (as appropriate) as compared to the aircraft simulated (see Appendix E1 and E3 (aeroplanes) or Appendix F1 and F3 (rotorcraft) as applicable);
 - g. FTD systems and sub-systems, including force cueing (motion), visual, and aural (sound) systems, as appropriate (see Appendix E1 and F2 (aeroplanes) or Appendix E1 and F2 (rotorcraft) as applicable); and
 - h. Certain additional requirements, depending upon the qualification level sought, including equipment or circumstances that may become hazardous to the occupants. The sponsor may be subject to Occupational Safety and Health Administration requirements.
- 6.14.3 The evaluator will administer the objective and subjective tests, which includes an examination of functions. The tests include a qualitative assessment of the FTD by a TC pilot.
- a. Objective tests provide a basis for measuring and evaluating FTD performance and determining compliance with the requirements of this chapter.
 - b. Subjective tests provide a basis for:
 - 1) Evaluating the capability of the FTD to perform over a typical utilization period;
 - 2) Determining that the FTD satisfactorily simulates each required task;
 - 3) Verifying correct operation of the FTD controls, instruments, and systems; and
 - 4) Demonstrating compliance with the requirements of this manual.
- 6.14.4 In addition to the scheduled continuing qualification evaluation, each FTD is subject to evaluations conducted by the NSEP or Regional Authority at any time without prior notification to the sponsor. Such evaluations would be accomplished in a normal manner (i.e. requiring exclusive use of the FTD for the conduct of objective and subjective tests and an examination of functions) if the FTD is not being used for pilot training and checking. However, if the FTD were being used, the evaluation would be conducted in a non-exclusive manner. The FTD evaluator will accompany the instructor aboard the FTD along with the student(s) and observe the operation of the FTD during the training, testing, or checking activities in a non-interference manner.
- 6.14.5 If it is determined that the results of an objective test do not support the level requested but do support a lower level, the Regional Authority may qualify the FTD at that lower level or remove an additional qualification to permit the device to enter into training.
- 6.14.6 After an FTD is evaluated and deemed compliant, the Regional Authority issues a Qualification Certificate to the sponsor. The Certificate is also the Regional Authority's recommendation to the TPAA that the FTD may be used in a TC approved training program.
- 6.14.7 The numbering system used for objective test results in the QTG should closely follow the numbering system set out in Appendix E2, Table E2A (aeroplanes) or Appendix F2, Table F2A (rotorcraft) as applicable.

6.15 Continuing Qualification Evaluations and Requirements

- 6.15.1 The sponsor must conduct objective tests at least once annually and retain test results and the FTD defect log for at least two consecutive years.

- 6.15.2 During the continuing qualification evaluation conducted by the Regional Authority, the sponsor must also provide a person knowledgeable about the operation of the aircraft and the operation of the FTD.
- 6.15.3 The Regional Authority will ensure the frequency of continuing qualification evaluations is in accordance with the requirements of CAR 606.03 unless the Regional Authority becomes aware of discrepancies or performance problems with the device that warrants more frequent evaluations.
- 6.15.4 The continuing qualification evaluations will normally require 4 hours of FTD time. The sponsor should anticipate that evaluations will consist of the following:
- a. Review of the sponsor-conducted objective tests results and defect log.
 - b. A random selection of objective tests from the MQTG that provide an adequate opportunity to evaluate the performance of the FTD. The tests chosen will be performed manually and should be able to be conducted within approximately one-third of the allotted FTD time.
 - c. A subjective evaluation of the FTD to perform a representative sampling of the tasks set out in Appendix E3 (aeroplanes) or Appendix F3 (rotorcraft) as applicable. This portion of the evaluation should take approximately two-thirds of the allotted FTD time.
 - d. An examination of the functions of the FTD may include the motion system, visual system, sound system, instructor operating station, and the normal functions and simulated malfunctions of the aircraft systems. This examination is normally accomplished simultaneously with the subjective evaluation requirements.

Appendix E1 - Aeroplane Non-Type-Specific FTD – General Simulator Requirements

1. This Appendix describes the general simulator requirements for qualifying an aeroplane non-type-specific FTD (Levels 1 and 2) and additional FTD qualifications for IPC and MCC. The sponsor should also consult the objective tests in Appendix E2 and functions and subjective tests listed in Appendix E3 of this to determine the complete requirements for an aeroplane specific level simulator.
2. The material contained in this Appendix is divided into the following categories:
 - a. General flight deck configuration.
 - b. Simulator programming.
 - c. Equipment operation.
 - d. Equipment and facilities for instructor/evaluator functions.
 - e. Motion system.
 - f. Visual system.
 - g. Sound system.
3. Table E1A provides the standards for the General Simulator Requirements.
4. Table E1B provides the tasks that the sponsor will examine to determine whether the FTD satisfactorily meets the requirements for flight crew training, testing, and experience, and provides the tasks for which the simulator may be qualified.

Table E1A - Aeroplane - Non-Type-Specific FTD - Minimum FTD Requirements

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements						
Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
1. GENERAL COCKPIT/ FLIGHT DECK CONFIGURATION						
1.a	Cockpit/ Flight Deck Layout And Structure					
1.a.1	- An open, enclosed or perceived to be enclosed cockpit/flight deck area, excluding distraction, 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 physical arrangement, appearance, and operation of controls, instruments, and switches should model at least one aircraft in the class of aircraft represented as closely as practicable. - A generic aircraft instrument panel must include at least the following: - Master/battery; - Magnetos for each engine (as applicable); - Alternators for each engine; - Fuel boost pumps for each engine; - Avionics master; - Pitot heat; and - Rotating beacon/strobe, navigation, taxi, and landing lights. - The flight instrument panel(s) position and crew member seats should provide the crew member(s) with a representative posture at the controls and a representative design eye position.	X				The assembled components should be compatible and function in a cohesive manner.
1.a.2	An enclosed or perceived to be enclosed cockpit/flight deck, excluding distraction, which is spatially representative of a single set of aeroplanes 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 cockpit/flight deck enclosure need only be representative of that in the single set of aeroplanes and should include windows. - The enclosure need only extend to the aft end of the cockpit/flight deck. - If the FSTD is used for VFR training, 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. - a representation of the set of aeroplanes or class of aeroplanes comparable to the actual aeroplane used for flight training.		X	X	X	- 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). - 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 single set of aeroplanes, which may require some controls,

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
						instruments, panels, masking, etc. to be changed for some conversions.
1.a.3	- Cockpit/flight deck configuration must be representative of a multi-engine aeroplane. - Flight controls; engine and propeller controls as applicable; systems and controls; circuit breakers; flight instruments; navigation and communications equipment; and caution and warning systems must support multi-pilot operation.			X		MCC and IPC training or checking on FTDs simulating aeroplanes that require a type-rating may only be conducted on type-specific FTDs.
1.a.4	- Cockpit/flight deck must represent an aeroplane or set of aeroplanes that allow single-pilot IFR flight for Group 1 or Group 3 Instrument proficiency checking. - The following instruments shall be located approximately in the same positions on the instrument panels of both pilots: - Airspeed indicator - Attitude indicator - Altimeter - HSI - Vertical speed indicator - ADF or RMI				X	MCC and IPC training or checking on FTDs simulating aeroplanes that require a type-rating may only be conducted on type-specific FTDs.
1.b	Flight Crew Seating					
1.b.1	Flight 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.	X				If a visual is installed.
1.b.2	Crew seats shall have sufficient adjustments to allow the occupant to achieve the design eye reference position appropriate to the aeroplane and for the visual system to be installed to align with that eye position.		X	X	X	
1.c	Cockpit/Flight Deck Lighting - Lighting environment for panels and instruments should be sufficient for the operation being conducted.	X	X	X	X	
2. PROGRAMMING						
2.a	Aerodynamic and engine modelling must be derived from and appropriate to:					
	– An aeroplane class to support the approved use (i.e. - not required to be specific to, model, type or variant).	X		X		
	– An aeroplane type or set of aeroplanes to support the approved use.		X		X	
	– 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.	X	X	X	X	

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
	As a minimum, the aeroplane's flight modeling should be comparable to a designated aeroplane class in the following areas: – Aircraft performance parameters (such as maximum speed, cruise speed, stall speed, maximum climb rate) – Aircraft vertical lift component must change as a function of bank – modelling must reflect the rolling movement due to yawing – Changes in flap setting, slat setting, gear position must be accompanied by changes in flight dynamics, – The presence and intensity of wind and turbulence must be reflected in the handling and performance qualities of the simulated aircraft	X	X	X	X	
	Aerodynamic modelling must reflect the effects of airframe icing. (weight increase).			X		
2.b	Computer Capacity: Sufficient FSTD computer capacity, accuracy, resolution and dynamic response to fully support the overall FSTD fidelity needed to support the approved use.	X	X	X	X	
3. GROUND REACTION AND HANDLING CHARACTERISTICS						
3.a	• Generic ground reaction and ground handling models to enable touchdown effects to be reflected by the sound and visual systems.	X				Applicable if a visual is installed.
3.b	Representative aeroplane ground handling simulation to include: • Ground reaction. Reaction of the aeroplane upon contact with the runway during take-off, landing and ground operations to include tire friction, side forces and other appropriate data, such as weight and speed, necessary to identify the flight condition and configuration; and • Ground handling characteristics. Steering inputs to include crosswind, braking, thrust reversing, deceleration and turning radius.		X	X	X	
3.c	Runway Conditions. Stopping and directional control forces for dry runway conditions.	X	X	X	X	• For Level 1: Applicable if a visual is installed. • If Runway contamination effects are installed, they will be subject to evaluation.

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
4. AEROPLANE SYSTEMS						
4.a	Aeroplane systems installed in the FSTD should represent 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.	X	X	X	X	- Aeroplane system operation should be predicated on, and traceable to, the system data supplied by either the aeroplane manufacturer, 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.
	- The FSTD must include at least three (3) (designated) aircraft systems that are sufficiently operational to support multi-crew coordination training in both normal and abnormal operations. - Installed systems must simulate the applicable aeroplane system operation. Systems shall be operative to the extent that it shall be possible to perform all normal, abnormal and emergency operations as may be appropriate for the aeroplane and as required for training.			X		- Examples of aircraft systems that support MCC training are: pressurization systems; hydraulic systems; fuel systems; electrical system; flight control systems. The system abnormal operation should engage multi-crew activity and support MCC procedural training objectives. - Sponsor must designate a minimum of 3 systems intended for MCC qualification prior to the initial evaluation.
4.b	Circuit breakers					
	A representative circuit breaker panel(s) should be presented (photographic reproductions are acceptable) and located in a spatially representative location(s).		X	X	X	
	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.	X	X	X	X	

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
4.f	Anti-icing systems corresponding to those typically installed in that class of aeroplanes should be operative.	X	X	X	X	- Simplified airframe and engine, including engine induction and pitot-static system, icing models with corresponding performance degradations due to icing should be provided. - Effects of anti-icing/de-icing systems activation should also be present.
5. Physical Flight and Aircraft System Controls						
5.a	- Physical flight and aircraft system controls must be recognizable as to their function and how they are to be manipulated solely from their appearance. - The technique, effort, travel and direction required to manipulate physical flight and aircraft system controls must, as applicable, be representative of those in the aeroplane or class of aeroplanes - Control systems should allow basic aeroplane operation with appropriate cockpit indications. - Active force feedback is not required.	X				- Physical flight and aircraft system controls may not be simulated using interfaces such as a keyboard, mouse, or gaming joystick to control the represented aircraft model in simulated flight. - Rudder pedals must be secured to the cockpit floor structure, or physically secured to the floor beneath the device in proper relation to cockpit orientation.
5.b	- Control systems operation should replicate at least one aeroplane aircraft in the set of aeroplanes simulated for 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. - Active force feedback required.		X	X	X	- The use of flat display technologies with physical overlays incorporating operational switches/knobs/ buttons replicating an aeroplane instrument panel may be acceptable. - If the FSTD is convertible, some primary and secondary flight controls may need to be changed for some conversions. *As applicable to abnormal modes installed.
5.c	Any additional equipment installed in the FTD and intended for use in approved training must be operated in the same manner in which it would be operated in the represented aircraft. For example, landing gear, wing flaps, cowl flaps, carburetor heat control, and mixture, propeller, and throttle controls.	X	X	X	X	

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
5.d	Physical flight and aircraft system controls must be provided as follows as a minimum: • A self-centring displacement yoke or control stick that allows continuous adjustment of pitch and bank; • Self-centring rudder pedals that allow continuous adjustment of yaw; • Throttle or power control(s) that allows continuous movement from idle to full power settings; • Mixture/condition, propeller, and throttle/power control(s) as applicable to the aeroplane set or class;	X	X	X	X	
	• Controls for the following items, as applicable to the airplane set or class represented: – Wing flaps, – Pitch trim (manual or electric pitch trim) permitting indicator movement either electrically or analogue in an acceptable trim ratio,; – Communication and navigation radios, including a RNP approach capability minimum GNSS (LNAV). – Clock or timer, – Gear handle (if applicable), – Transponder – Altimeter, – Microphone with push-to-talk switches, – Carburetor heat (if applicable), and – Cowl flaps (if applicable).	X*	X		X	The FTD must have navigation controls, displays, and instrumentation for powered aeroplanes as set out CAR 605.18 for IFR operation. * Level 1 does not require RNP approach capability. However, if installed it must function as per design.
	• An FTD used for MCC training must have the following features: – Retractable landing gear – Pressurization system – De-icing/anti-icing systems – Fire detection and suppression system – Dual controls – Flight director – Autopilot with approach mode – 2 VHF transceivers – Oxygen masks with intercom system – 2 VHF Nav receivers (VOR ILS DME) – 1 ADF receiver – RNP approach capability - minimum GNSS (LNAV). – 1 transponder – A stopwatch accessible from both sides or two stopwatches			X		

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
6. NAVIGATION AND INSTRUMENT REQUIREMENTS						
6.a	Navigation environment					
6.a.1	Sufficient navigation equipment necessary to fly instrument approaches to support the approved use.	X	X	X	X	
6.a.2	Instrument Indications. All relevant instrument indications involved in aeroplane or class of aeroplanes simulated should automatically respond to control movement by a flight crew member or to atmospheric disturbance and also respond to effects resulting from icing.	X	X	X	X	Numerical values should be presented in the appropriate units.
6.a.3	Navigation Database. Navigation database sufficient to support simulated aeroplane systems for real world operations.	X	X	X	X	Includes FTD database of external environment and internal aeroplane equipment databases (i.e. FMS or GPS) as applicable, to conduct RNP approaches.
6.a.4	Minimum Airport Navigation Requirement. Complete navigation database for at least 3 designated airports with corresponding precision and non-precision approach procedures, including regular updates to support approved use.	X	X	X	X	Sponsor must designate a minimum of 3 airports supporting the navigation requirement prior to the initial evaluation.
6.a.5	Instructor Controls. Instructor controls of internal and external navigational aids.	X	X	X	X*	- E.G. - aeroplane ILS glideslope receiver failure compared to ground facility glideslope failure. *Provide a means to stimulate a RAIM or integrity warning alert to the pilot. (See note 3 & 4 at entry # 6.a.7)
6.a.6	Navigation Aids Range. Navigation aids should be usable within range or line-of-sight without restriction, as applicable to the geographic area.	X	X	X	X	Replication of the geographic environment with its specific limitations.

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
6.a.7	The GPS must be able to: - display the validity period or expiry date of the database and provide a means to verify serviceability of the unit (i.e. the start-up self-test feature) to support pre-flight checks required by Item 1.C. Cockpit Checks of TP 9939 (see note 1); - Display the selected approach from the GPS navigator database; - Properly and automatically sequence from each waypoint to the next during the approach,; - Provide a means for the pilot to verify that the approach mode has been activated, - When the approach mode is armed, activate the approach mode within 2 NM of the Final Approach Waypoint (FAWP), - When the approach mode is activated, appropriately change the Receiver Autonomous Integrity Monitoring (RAIM) and CDI sensitivity (see note 2); - allow the pilot to fly the entire missed approach procedure including any published holds/shuttle climbs in IMC; - Have the ability to generate and display a RAIM / Integrity warning when selected from the instructor/examiner station (see note 3 & 4).		X		X	Note 1. Outdated databases are allowed, as long as matching approach plates are available and the database is updated at least annually. The FTD operator must develop processes to track and document the updates. Note 2. The GPS shall then, beginning 2 NM prior to the FAWP, have the full scale CDI sensitivity smoothly change from ± 1 NM to ± 0.3 NM at the FAWP). Note 3. The ability to recognize and manage integrity warnings is a required element of training towards an initial IFR flight test and/or an IPC, even if the recognition and management of integrity warnings are not a required part the IPC. Should an actual integrity warning occur during an initial IFR flight test that is conducted in an aircraft, candidates are expected to manage the warning appropriately. Note 4. Some integrated GNSS systems that are WAAS capable may incorporate an Integrity warning instead of a traditional RAIM warning.
6.b	Instruments and Indicators (as appropriate and applicable to the aeroplane or class of aeroplane represented)					
6.b.1	Flight instruments in a standard configuration, represented either as separate traditional “round” flight instruments, or as an electronic primary flight instrument display with reversionary and back-up flight instruments.	X	X	X	X	
6.b.2	A sensitive <u>altimeter</u> with incremental markings each 20 feet or less, operable throughout the normal operating range of the aeroplane or class of aeroplane represented.	X	X	X	X	
6.b.3	A <u>magnetic compass</u> which displays incremental markings typical of that shown in the aeroplane or class of aeroplane represented.	X	X	X	X	

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
6.b.4	A <u>heading indicator</u> with incremental markings each 5 degrees or less, displayed on a 360 degree circle. Arc segments of less than 360 degrees may be selectively displayed if desired or required, as applicable to the aeroplane or class of aeroplane represented.	X	X	X	X	
6.b.5	An <u>airspeed indicator</u> with incremental markings as shown on the aeroplane or class of aeroplane represented; airspeed markings of less than 40 knots need not be displayed.	X	X	X	X	
6.b.6	A <u>vertical speed indicator</u> with incremental markings each 100 feet per minute (fpm) for both climb and descent, for the first 1,000 fpm of climb and descent, and at each 500 fpm climb and descent for the remainder of a minimum $\pm 2,000$ fpm total display, or as applicable to the aeroplane or class of aeroplane being represented.	X	X	X	X	
6.b.7	A <u>gyroscopic rate-of-turn indicator</u> or equivalent with appropriate markings for a rate of 3 degrees per second turn for left and right turns. If a turn and bank indicator is used, the 3 degrees per second rate index must be inside of the maximum deflection of the indicator.	X	X	X	X	
6.b.8	A <u>slip and skid indicator</u> with coordination information displayed in the conventional skid ball format where a coordinated flight condition is indicated with the ball in the centre position. A split image triangle indication may be used if applicable to the aeroplane or class of aeroplane being represented.	X	X	X	X	
6.b.9	An <u>attitude indicator</u> with incremental markings each 5 degrees of pitch or less, from 20 degree pitch up to 40 degree pitch down or as applicable to the aeroplane or class of aeroplane represented. Bank angles must be identified at “wings level” and at 10, 20, 30, and 60 degrees of bank (with an optional additional identification at 45 degrees) in left and right banks.	X	X	X	X	
6.b.10	<u>Engine instruments</u> as applicable to the aeroplane or class of aeroplane being represented, providing markings for normal ranges and minimum and maximum limits (including a fuel quantity indicator(s) that displays the fuel remaining, either in analogue or digital format).	X	X	X	X	
6.b.11	A <u>suction gauge or instrument pressure gauge</u> , as applicable, with a display applicable to the aeroplane or class of aeroplane represented.	X	X	X	X	
6.b.12	A <u>flap setting indicator</u> that displays the current flap setting. Setting indications should be typical of that found in an actual aircraft.	X	X	X	X	
6.b.13	A <u>pitch trim indicator</u> with a display that shows zero trim and appropriate indices of airplane nose down and airplane nose up trim, as would be found in an aircraft.	X	X	X	X	
6.b.14	<u>Communication radio(s)</u> with display(s) of the radio frequency in use.	X	X	X	X	If appropriate to the MCC training being conducted, an oxygen mask microphone system must be included.

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
	Communication equipment (intercom and air/ground) corresponding to that installed in the replicated aeroplane including an oxygen mask microphone/communication system			X		•
6.b.15	- Navigation radio(s) capable of replicating both precision and non-precision instrument, including approach procedures (each aural identification as applicable). The marking should include: - One-half dot or less for course/glide slope deviation (i.e., VOR, LOC, or ILS), 5 degrees or less for bearing deviation for automatic direction finder (ADF) and radio magnetic indicator (RMI), as applicable, - A clock with incremental markings for each minute and second, or a timer with a display of minutes and seconds, - A magnetic compass with incremental markings each 10 degrees or less; The compass must display the proper lead or lag during turns, - A transponder panel that displays the current transponder setting, - Communications, navigation, and caution and warning equipment corresponding to that typically installed in the set of aeroplanes or class of aeroplane (as applicable) being simulated should operate within the tolerances prescribed for the applicable airborne equipment.	X	X	X	X	- For example, an ILS, non-directional radio beacon (NDB), Global Positioning System (GPS), Localizer (LOC) or Very high frequency Omnidirectional Range (VOR). Graduated markings as indicated below must be present on each indication as applicable. - For RNAV/RNP instrument scaling must be appropriate to the flight operational phase (i.e. enroute, terminal, and approach)
	The FTD must have navigation controls, displays, and instrumentation for powered aeroplanes as set out CAR 605.18 for IFR operation. and permit the track of the aircraft to be monitored by means of information presented on a Primary Flight display (Horizontal Situation Indicator (HSI) or Course Deviation Indicator (CDI);				X	For IPC qualification, the FTD must include navigation controls, displays, and instrumentation and navigation malfunctions necessary to conduct an Instrument Proficiency Check as prescribed in TP9939 – Flight Test Guide as amended.
6.b.16	Displays must reflect dynamic behaviour of an actual aircraft display (e.g., a VSI reading of 500 fpm must reflect a corresponding movement in altimeter, and an increase in power must reflect an increase in rpm indication or power indication).	X	X	X	X	

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
6.b.17	- Display update must be at a frequency of 10 hertz (Hz) or higher. Each display must sense a change and react at a value less than the stated. - Display updates must display all changes (within the total range of the replicated instrument) that are equal to or greater than the values stated below: - Airspeed indicator: change of 5 knots, - Attitude indicator: change of 2 degrees in pitch and bank, - Altimeter: change of 10 feet, - Turn and bank: change of ¼ standard rate turn - Heading indicator: change of 2 degrees, - Vertical speed indicator (VSI): change of 100 fpm, - Tachometer: change of 25 rpm or 2 percent of turbine speed, - VOR/ILS: change of 1 degree for VOR or ¼ of 1 degree for ILS, - ADF: change of 2 degrees, - GPS: Change as appropriate for model of GPS-based navigator represented, and - Clock or timer: change of 1 second	X	X	X	X	
6.b.18	- All instrument displays listed above must be visible during all flight operations. The update rate of all displays must provide an image of the instrument that: - Does not appear to be out of focus or illegible, - Does not appear to “jump” or “step” to a distracting degree during operation, and - Does not appear with distracting jagged lines or edges.	X	X	X	X	
	- Primary flight and navigation instruments approximately life sized that exhibit neither stepping nor excessive transport delay, and arranged so as to observe trends and provide a realistic scan pattern; - Digital avionics panel as applicable to approved use; - GPS navigator		X	X	X	
7. VISUAL SYSTEM						
NOTE: Level 1 FTD does not require a visual system; however, if one is installed it must meet the minimum requirements for a Level 2 FTD as indicated in this section (7)..						
7.a.	If a visual system is installed, it must meet the following criteria:					
7.a.1	- The visual system must respond to abrupt input at the pilot's position. - An SOC is required.		X	X	X	
7.a.2	- The visual system must be at least a single channel, non-collimated display. - An SOC is required.		X			

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
7.a.3	- A field of view of a minimum of 45° horizontally and 30° vertically for each training pilot position, unless restricted by the type of aeroplane. - An SOC is required.		X			For flat-panel (direct view) displays: - The FOV must be continuous and free of physical obstructions or viewing plane discontinuities (i.e. Panel joints) as measured from the training pilot's eye-point. - The visual horizon must be continuously aligned across all adjoining panels and with and respond in a synchronized manner to pilot inputs.
7.a.4	- Continuous visual field of view providing each pilot with minimum of 150° horizontal and 30° vertical field of view, unless restricted by the type of aeroplane designated. - The visual system must be installed to align with that design eye reference position.		X*	X	X	*Required for Level 2 if VFR cross-country training is intended.
7.a.5	- The visual system must provide for a maximum parallax of 10° per pilot. - An SOC is required.			X		
7.a.6	Non-collimated or direct view visual system must have the capability to align the visual presentation to the pilot flying.		X	X	X	
7.a.7	- The visual scene content may not be distracting. - An SOC is required.		X	X	X	
7.a.8	- 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. - An SOC is required.		X	X	X	For flat-panel (direct view) displays, the minimum distance of side panels must be no closer to the pilot eye-point than that forward panels.
7.a.9	- The visual system must provide for a minimum resolution of 5 arc-minutes for both computed and displayed pixel size. - An SOC is required.		X	X		
7.a.10	Display resolution is adequate to support the approved use.		X			
7.a.11	Light-Point Size Light-point size — not greater than 8 arc minutes.		X	X	X	
7.a.12	Display Contrast Ratio Suitable to support the approved use.		X	X	X	
7.a.13	Light-Point Contrast Ratio Suitable to support the approved use.		X	X	X	
7.a.14	Light-Point Brightness Light-point brightness – not less than 20 cd/m ² (5.8 foot-lamberts).		X	X	X	

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
7.a.15	Display Brightness Display brightness should be demonstrated using a raster drawn test pattern. The surface brightness should not be less than 14 cd/m2 (4.1 foot-lamberts).		X	X	X	
7.a.16	Black Level and Sequential Contrast (Light valve systems only) Suitable to support the approved use.		X	X	X	
7.a.17	Motion Blur (Light valve systems only) Suitable to support the approved use.		X	X	X	
7.a.18	Speckle Test (Laser systems only) Suitable to support the approved use.		X	X	X	
7.a.19	The FTD must provide visual effects for: – Light poles; – Raised edge lights as appropriate; and – Glow associated with approach lights in low visibility before physical lights are seen (<i>required only if low visibility training is intended.</i>)				X	Visual effects for light poles and raised edge lights are for the purpose of providing additional depth perception during takeoff, landing, and taxi training tasks. Three dimensional modeling of the actual poles and stanchions is not required.
8. EXTERNAL ENVIRONMENT						
8.a	Atmosphere And Weather					
8.a.1	Simulation of the standard atmosphere including instructor control over key parameters.	X	X	X	X	
8.a.2	The FSTD should employ wind shear models that provide training for recognition of wind shear phenomena.		X	X		
8.a.3	Visibility as observed on the visual system should be simulated and respective instructor controls provided.		X	X	X	
8.b	Airports And Terrain					
8.b.1	- The system should provide a visual scene with sufficient 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 to support the approved use. - Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways to support approved use.		X	X	X	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.
	Generic airport models with topographical features to support the approved use.	X				If visual installed

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
	- Minimum of one (1) designated airport-specific model 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. - Visual terrain and EGPWS databases should be matched to support procedural CFIT training if intended.		X	X		- Where the device is required to perform low visibility operations, at least one (1) specific airport scene with functionality to support the approved use. (e.g. low visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting.) - Sponsor must designate a minimum airport specific models prior to the initial evaluation.
	- Minimum of three (3) designated airport-specific models 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 to support the approved use. - Each designated airport must have at least one Required Navigation Performance (RNP) approach with all waypoints as named on the approach plate in the correct order and with the correct bearing and distances between waypoints is available at each airport;				X	
8.c	Visual Cues					
8.c.1	This should include: - Surface on runways, taxiways, and ramps; - Terrain features;		X	X	X	
	For specific VFR cross-country training, highly detailed and accurate surface depiction of the terrain surface within an area sufficient to achieve cross-country flying under VFR conditions.		X			
	Visual cues to assess sink rate and depth perception during take-off and landing should be provided.		X	X	X	
	- 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. - When the aircraft reaches the Missed Approach Point (MAP), provide visuals that correspond to the position of the aircraft and provide sufficient realism to allow the candidate to make the decision to continue the approach with a normal visual transition and landing or initiate the missed approach procedure.				X	
8.d	Attitude					
8.d.1	The FSTD should provide for accurate portrayal of the visual environment relating to the FSTD attitude.	X	X	X	X	For Level 1 – if visual installed.
8.e.	Airport Scenes					
8.e.1	The system should include at least 3 designated real-world airports available in daylight, twilight (dusk or dawn) and night illumination states.				X	

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
8.e.2	The system should include at least 1 designated real-world airport available in daylight, twilight (dusk or dawn) and night illumination states.		X	X		
8.e.4	Daylight Capability.		X	X	X	
8.e.5	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).		X	X	X	
8.e.6	Surface shading effects should be consistent with simulated sun position.		X	X	X	
8.e.7	Total scene content comparable in detail to that produced by 10 000 visible textured surfaces and 6 000 visible lights should be provided.		X	X	X	
8.e.8	Total scene content should be sufficient to identify the airport and represent the surrounding terrain.		X	X	X	
8.e.9	The system should have sufficient capacity to display 16 simultaneously moving objects.		X	X	X	
8.e.10	Twilight (dusk) capability.		X	X	X	
8.e.11	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 own-ship-lighting (e.g. landing lights) sufficient to successfully accomplish visual approach, landing and airport movement (taxi).		X	X	X	
8.e.12	Total scene content comparable in detail to that produced by 10 000 visible textured surfaces and 15 000 visible lights should be provided.		X	X	X	
8.e.13	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).		X	X	X	
8.e.14	The system should include a definable horizon.		X	X	X	
8.e.15	The system should have sufficient capacity to display 16 simultaneously moving objects.		X	X	X	
8.e.16	Night capability.		X	X	X	
8.e.17	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).		X	X	X	

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
8.e.18	Airport Clutter. Airport models should include representative static and dynamic clutter such as gates, aeroplanes, and ground handling equipment.		X	X	X	
9. MOTION SYSTEM.						
9.a.	- The FTD may have a motion system, if desired, although it is not required. If a motion system is installed, the motion system operation must not be distracting and must be coupled closely to provide integrated sensory cues. - The motion system must also respond to abrupt input at the pilot's position within the allotted time, but not before the time when the aeroplane responds under the same conditions.	X	X			The motion system standards set out in this manual, Appendix A1 for at least Level A simulators are acceptable.
10. SYSTEM INTEGRATION						
10.a	Transport delay: - Transport delay may not exceed 300 milliseconds. - An SOC is acceptable in lieu of testing, however, testing for initial evaluation may be required to verify the SOC if latency calculations in the SOC are close to tolerance.			X	X	If a motion system is installed, it must be measured by latency tests or transport delay tests and may not exceed 300 milliseconds. Instrument and visual response may not occur prior to motion onset.
11. SOUND SYSTEM						
11.a	- Significant sounds perceptible to the flight crew during flight operations to support the approved use. - Comparable engine and airframe sounds.	X				
11.b	Significant cockpit/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.		X	X	X	
11.c	The volume control must have an indication of sound level setting for approved use.		X	X	X	This indication is of the sound level setting as evaluated during the FTD's initial evaluation.
11.d	The sound of a crash when the simulated aeroplane exceeds limitations.		X	X	X	

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
11.e	- The volume control should have an indication of sound level setting for approved use. - 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.	X	X	X	X	
12. INSTRUCTOR OR EVALUATOR FACILITIES.						
12.a	In addition to the flight crew member seats, there should be an instructor station seat and one suitable seats for an observer or a TC inspector. The instructor station should provide an adequate view of the pilots' panels and forward windows.	X	X	X	X	- For MCC and IPC qualifications - At least one seat should have a system to permit monitoring of all flight crew member and instructor communications. - These seats need not be a replica of an aircraft seat and may be as simple as an office chair placed in an appropriate position. - The MSP will consider alternatives alternate-seating based on unique flight deck configurations. - For an FSTD with a motion cueing system, any instructor seat on board the motion platform must 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.

Table E1A – Aeroplane Non-Type-Specific FTD- Minimum Simulator Requirements

Entry No.	Minimum FTD Requirements	FTD Level		Addition Qualification		Notes
		1	2	MCC	IPC	
12.b	- The FTD must have instructor controls that permit: - Control of all required system variables, freezes, resets, and - Activation of failures in navigation and instruments, radio receivers, landing gear and flaps, engine power (partial and total), and other aircraft systems (pitot, electric, static, etc.) to support the approved use. - Once activated, proper system operation must result from system management by the crew and not require input from the instructor controls	X	X	X	X	The effects of malfunctions should be sufficient to correctly exercise the procedures in relevant operating manuals.
12.c	The FTD must have IOS instructor controls for the following expected environmental effects to support the approved use:	X	X	X	X	
	Surface wind speed, direction and gusts			X	X	
	Intermediate and high altitude wind speed and direction as appropriate;			X		
	Thunderstorms and microbursts; and			X		
	Turbulence.	X	X	X	X	Only instrument effects are required.
12.d	The simulator must provide the instructor or evaluator the ability to present ground and air hazards.			X	X	For example, another aeroplane crossing the active runway or converging airborne traffic.
12.e	Oversee tracks along airways, holding entries and patterns, and localizer and glide slope alignment/deviation (or other approaches with a horizontal and vertical track);		X		X	

Table E1B –Aeroplane - Non-Type-Specific FTD - Tasks vs. FTD Level – Subjective Requirements

Note: Items not installed or not functional on the FTD and not appearing on the Qualification Certificate Configuration List, are not required to be listed as exceptions on the Qualification Certificate.

Table E1B – Aeroplane Non-Type-Specific FTD - Subjective Requirements					
Entry #	Functions and Subjective Tests	Level		Qualification	
		1	2	-MCC	-IPC
1- 2 PREFLIGHT PROCEDURES.					
1.	Pre-flight Inspection (flight deck only) (Appropriate checklists must be available in FTD).	X	X	X	X
2.a	Engine Start	X	X	X	X
2.b	Taxiing		X	X	X
3. TAKEOFF AND DEPARTURE PHASE.					
3.a.1	Pre-takeoff Checks	X	X	X	X
3.a.2	Normal and Crosswind Takeoff		X	X	X
3.a.3	Instrument Takeoff		X	X	X
3.b	Rejected Takeoff - Consistently controllable within runway width to support approved use.		X	X	X
3.c	Departure Procedure		X	X	X
4-6 INFLIGHT MANEUVERS.					
4.	Normal climb	X	X	X	X
5.a	Steep Turns	X	X	X	X
5.b	Approaches to Stall	X	X	X	X
5.c	Engine Failure—Multiengine Aeroplane		X	X	X
5.d	Engine Failure—Single-Engine Aeroplane		X		
5.e	Specific Flight Characteristics incorporated for TC approved flight training program.	X	X	X	X
6.	Normal decent	X	X	X	X
7. INSTRUMENT PROCEDURES					
7.a	Standard Terminal Arrival / Flight Management System Arrivals Procedures	X	X	X	X
7.b	Holding	X	X	X	X
7.c	Precision Instrument - All engines operating.	X	X	X	X
7.d	Precision Instrument - One engine inoperative.	X	X	X	X
7.e	Non-precision Instrument Approach. (For IPC, the FTD must simulate an RNP approach.)	X	X	X	X
8. LANDINGS AND APPROACHES TO LANDINGS.					
8.a	Normal and Crosswind Visual Approaches and Landings		X	X	X
8.b	Landing From a Precision / Non-Precision Approach		X	X	X
8.c	Approach and Landing with (Simulated) Engine Failure – Multiengine Aeroplane		X	X	X
8.e	Rejected Landing		X	X	X
9. MISSED APPROACH.					
9.a	Normal.	X	X	X	X
9.b	One engine Inoperative.	X	X	X	X
10. POST-FLIGHT PROCEDURES.					
10.a	After-Landing Procedures	X	X	X	X
10.b	Parking and Securing	X	X	X	X
11. NORMAL AND ABNORMAL PROCEDURES. X* - indicates that the system, task, or procedure, although not required to be					

Table E1B – Aeroplane Non-Type-Specific FTD - Subjective Requirements

Entry #	Functions and Subjective Tests	Level		Qualification	
		1	2	-MCC	-IPC
present, may be examined if the appropriate aeroplane system is simulated in the FTD and is working properly.					
11.a	Engine (including shutdown and restart)	X	X	X	X
11.b	Fuel System	X	X	X	X
11.c	Electrical System	X	X	X	X
11.d	Hydraulic System		X*	X*	X*
11.e	Environmental and Pressurization Systems		X*	X*	X*
11.f	Fire Detection and Extinguisher Systems		X*	X*	X*
11.g	Navigation and Avionics Systems	X	X	X	X
11.h	Flight Control Systems	X	X	X	X
11.i	Anti-ice and Deice Systems	X	X	X	X
11.j	Aircraft and Personal Emergency Equipment		X*	X*	
11.k	Equipped and serviceable for instrument flight as set out in CAR 605.18 for IFR operations (as amended): - attitude indicator; - vertical speed indicator; - outside air temperature gauge; - anti- icing for each airspeed indicating system; - a power failure warning device or vacuum indicator showing power available to gyroscopic instruments from each power source; - an alternative source of static pressure for the altimeter, airspeed indicator and vertical speed indicator; - sufficient radio communication equipment; - sufficient radio navigation equipment to permit the pilot, in the event of the failure at any stage of the flight of any item of that equipment, including any associated flight instrument display, where the aircraft is operated in IMC, to complete an instrument approach and, if necessary, conduct a missed approach procedure to proceed to the destination aerodrome or proceed to another aerodrome that is suitable for landing. (Night) a means of illumination for all instruments used to operate the aircraft; (Night) a landing light;				X
11.l	EMERGENCY PROCEDURES. - Emergency Descent (Max. Rate) - Inflight Fire and Smoke Removal - Rapid Decompression - Emergency Evacuation		X*	X*	
12. VISUAL SYSTEM (Appropriate for approved use)			X	X	X
16. INSTRUCTOR OPERATING STATION (IOS) FUNCTIONS, AS APPROPRIATE.					
16.a	Power switch (es).	X	X	X	X
16.b	Aeroplane conditions	X	X	X	X
16.c	Airports / Runway.	X	X	X	X
16.d	Environmental controls	X	X	X	X
16.e	Aeroplane system malfunctions (insertion / deletion)	X	X	X	X
16.f	Locks, Freezes, and Repositioning	X	X	X	X
16.g	Sound Controls - On / Off / adjustment	X	X	X	X
16.h	Motion / Control Loading System - On / off / emergency stop As appropriate.	X	X	X	X
16.i	Observer Seats / Stations: Position / Adjustment / restraint (as appropriate).	X	X	X	X

Appendix E2 - Aeroplane Non-Type-Specific FTD – Objective Tests

1. In addition to subjective testing, non-type-specific FTDs will be subject to the applicable objective tests at Table E2A to ensure they meet qualification criteria initially and periodically throughout its life. The objective tests can be flown by a suitably skilled person and the results recorded manually.
2. The tolerances specified are designed to ensure that the device meets its original target criteria year after year. It is therefore important that such target data is carefully derived and substantiated prior to submitting the QTG to the inspecting authority prior to the QTG review and initial qualification. For initial qualification, it is highly desirable that the device should 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 intended to support recurrent inspection to ensure the device is maintained as approved during the initial evaluation. It is therefore important that the tests targets be representative and test results be repeatable during the life of the FSTD.
3. A number of tests within the QTG have had their tolerances reduced to "Correct Trend and Magnitude" (CT&M) thereby avoiding the need for specific validation data. The use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. For such tests, the performance of the FSTD should be appropriate and representative of the simulated designated aeroplane and should under no circumstances exhibit negative characteristics. Where CT&M is used as a tolerance, it is strongly recommended that targets are identified and used to footprint the baseline in order to avoid possible divergent subjective opinions during recurrent evaluations. Once a footprint target is established, then the applicable tolerance should be applied to results during recurrent evaluations.
4. Longitudinal change force tests. 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. 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.

NOTE: If change forces are small (within the tolerance band), it is acceptable to reduce change the end state airspeed to achieve a more measureable force provided the procedure is well documented and repeatable.

Table E2A – Aeroplane – Non-Type-Specific FTD - Objective Tests

Table E2A – Aeroplane – Non- Type-Specific FTD - Objective Tests									
Test		Tolerance	Flight Conditions	Test Details	Level		Qualification		Notes
Entry #	Title				1	2	MCC	IPC	
1. PERFORMANCE									
1.b	Ground acceleration time and distance.	±1.5 s or ±5% of time.	Take-off.	Acceleration time and distance should be recorded for a minimum of 80% of the total time from brake release to Vr. May be combined with normal take-off (1.b.4) or rejected take-off (1.b.7).		X			Plotted data should be shown using appropriate scales for each portion of the manoeuvre
	Rejected take-off.	±5% of time or ±1.5 s.	Take-off.	Record time for at least 80% of the time segment from initiation of the rejected takeoff to full stop.					
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	Flight test data are preferred; however, aeroplane performance manual data are an acceptable alternative. Record at nominal climb speed and mid initial climb altitude. FTD performance is to be recorded over an interval of at least 300 m (1 000 ft).	C T & M	X			This may be a snapshot test result.

Table E2A – Aeroplane – Non- Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Level		Qualification		Notes
Entry #	Title				1	2	MCC	IPC	
1.c	One-engine inoperative 2 nd 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			This may be a snapshot test result.
1.d.1	Level flight acceleration.	±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.		X			
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.		X			
1.f.1	Acceleration	±10% Ti or ± 1 s; and ±10% Tt or ± 1 s.	Approach or landing	Total response is the incremental change in the critical engine parameter from idle power to go-around power.	C T & M	X			• Ti = total time from initial throttle movement until a critical engine parameter reaches 10% of its total response below maximum take-off power. • Tt = total time from initial throttle movement until a critical engine

Table E2A – Aeroplane – Non- Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Level		Qualification		Notes
Entry #	Title				1	2	MCC	IPC	
1.f.2	Deceleration	±10% Ti or ± 1 s; and ±10% Tt or ± 1 s.	Ground	Total response is the incremental change in the critical engine parameter from idle power to go-around power.	C T & M	X			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.
2.a.1	Pitch controller position versus force	±0.9 daN (2 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force.	As determined by sponsor	Control forces and travel should broadly correspond to that of the replicated class of aeroplane.	C T & M				
				Record uninterrupted control sweep to stops during initial qualification The recorded tolerances apply to subsequent comparisons on continuing qualification evaluations.		X			Test results should be validated with in-flight data from tests such as longitudinal static stability, stalls, etc.

Table E2A – Aeroplane – Non- Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Level		Qualification		Notes
Entry #	Title				1	2	MCC	IPC	
2.a.2	Roll controller position versus force	±0.9 daN (2 lbf) breakout. ±1.3 daN (3 lbf) or ±10% of force.	As determined by sponsor	Control forces and travel should broadly correspond to that of the replicated class of aeroplane.	C				
				Record uninterrupted control sweep to stops during initial qualification The recorded tolerances apply to subsequent comparisons on continuing qualification evaluations.		X			Test results should be validated with in-flight data from tests such as engine-out trims, steady state side-slips, etc.
2.a.3	Rudder pedal position versus force	±2.2 daN (5 lbf) breakout.	As determined by sponsor	Control forces and travel should broadly correspond to that of the replicated class of aeroplane.	X				

Table E2A – Aeroplane – Non- Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Level		Qualification		Notes
Entry #	Title				1	2	MCC	IPC	
		±2.2 daN (5 lbf) or ±10% of force.		Record uninterrupted control sweep to stops during initial qualification The recorded tolerances apply to subsequent comparisons on continuing qualification evaluations.		X			Test results should be validated with in-flight data from tests such as engine-out trims, steady state side-slips, etc.
2.a.4.a	Nosewheel steering controller force and position calibration.	Correct trend and magnitude	Ground	Suitable for approved use.	C T & M	C T & M	C T & M	C T & M	As applicable to replicated aeroplane.
2.a.4.b	Rudder pedal steering calibration.	Correct trend and magnitude	Ground	Suitable for approved use.	C T & M	C T & M	C T & M	C T & M	
2.a.8	Alignment of cockpit throttle lever versus selected engine parameter.	Correct trend and magnitude. Parameter +/- 5% at: - full forward - full aft and 50% throttle position.	Ground					C T & M	Test must include a method of measuring 50% throttle position.

Table E2A – Aeroplane – Non- Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Level		Qualification		Notes
Entry #	Title				1	2	MCC	IPC	
2.C.1.b	Power Change Force.	±5 lb (2.2 daN) or, ±20% pitch control force.	Approach	Force tests should provide the force required to maintain constant airspeed or altitude to complete the configuration change.	C T & M	X			Force tests should provide the force required to maintain constant airspeed or altitude to complete the configuration change.
2.C.2.b	Flap/Slat Change Force.	±5 lb (2.2 daN) or, ±20% pitch control force.	Takeoff through initial flap retraction, and approach to landing.	Force tests should provide the force required to maintain constant airspeed or altitude to complete the configuration change.	C T & M	X			Force tests should provide the force required to maintain constant airspeed or altitude to complete the configuration change.
2.C.4.b	Gear Change Force.	±5 lb (2.2 daN) or, ±20% pitch control force.	Takeoff (retraction), and Approach (extension).	Force tests should provide the force required to maintain constant airspeed or altitude to complete the configuration change.	C T & M	X			Force tests should provide the force required to maintain constant airspeed or altitude to complete the configuration change.

Table E2A – Aeroplane – Non- Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Level		Qualification		Notes
Entry #	Title				1	2	MCC	IPC	
2.C.5	Longitudinal Trim.	$\pm 1^\circ$ elevator angle. $\pm 0.5^\circ$ stabilizer or trim surface angle. $\pm 1^\circ$ pitch angle. $\pm 5\%$ of net thrust or equivalent.	Cruise, Approach, and Landing.	Pitch controller position and/or trim controller position may be used instead of elevator angle and trim control position instead of stabilizer angle.	C T & M	X			
2.C.7	Longitudinal Static Stability.	± 2.2 daN (5 lbf) or $\pm 10\%$ of pitch controller force. Alternative method: $\pm 1^\circ$ or $\pm 10\%$ of the change of elevator angle.	Approach	Data for at least two speeds above and two speeds below trim speed. The speed range must be sufficient to demonstrate stick force versus speed characteristics. This test may be a series of snapshot tests.	C T & M	X			- Force tolerance is not applicable if forces are generated solely by the use of aeroplane hardware in the FTD. - Alternative method applies to aeroplanes which do not exhibit speed stability characteristics.
2.C.8.b	Stall Warning (actuation of stall warning device.)	± 3 kt airspeed for stall warning	Second Segment Climb, and Approach or Landing.	The stall maneuver must be entered with thrust at or near idle power and wings level (1g). Record the stall warning signal and initial buffet if applicable.	X	X			

Table E2A – Aeroplane – Non- Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Level		Qualification		Notes
Entry #	Title				1	2	MCC	IPC	
2.C.9.b	Phugoid Dynamics.	±10% period, Representative damping.	Cruise	The test must include whichever is less of the following: Three full cycles (six overshoots after the input is completed), or the number of cycles sufficient to determine representative damping.	C T & M	X			
2.d.2	Roll Response (Rate).	±2°/s or ±10% of roll rate.	Cruise, and Approach or Landing.	Test with normal roll control displacement (approximately one-third of maximum roll controller travel).	C T & M	X			
2.d.4.c	Spiral Stability.	Correct trend and ±3° or ±10% of roll angle in 20s.	Cruise	Aeroplane data averaged from multiple tests may be used	C T & M	X			• Test for both directions. • As an alternative test, show lateral control required to maintain a steady turn with a roll angle of approximately 30°.
2.d.6.b	Rudder Response.	Roll rate ±2°/sec, Bank angle ±3°. or ±2°/s or ±10% of yaw rate or ±10% of heading change.	Approach or Landing.	May be roll response to a given rudder deflection.	C T & M	X			• Test with stability augmentation on and off. • Test with a step input at approximately 25% of full rudder pedal throw.

Table E2A – Aeroplane – Non- Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Level		Qualification		Notes
Entry #	Title				1	2	MCC	IPC	
2.d.8	Steady State Sideslip.	For a given rudder position: • $\pm 2^\circ$ roll angle; • $\pm 1^\circ$ side-slip angle; • $\pm 2^\circ$ or $\pm 10\%$ of aileron angle; and • $\pm 5^\circ$ or $\pm 10\%$ of spoiler or equivalent roll controller position or force. For aeroplanes with reversible flight control systems: • ± 1.3 daN (3 lbf) or $\pm 10\%$ of wheel force. • ± 2.2 daN (5 lbf) or $\pm 10\%$ of rudder pedal force.	Approach or Landing.	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 must be near maximum allowable rudder. Roll controller position instead of aileron angle may be used.	C T & M	X			Side-slip angle is matched only for repeatability and only on continuing recurrent evaluations.

Table E2A – Aeroplane – Non- Type-Specific FTD - Objective Tests

Test		Tolerance	Flight Conditions	Test Details	Level		Qualification		Notes
Entry #	Title				1	2	MCC	IPC	
4.a.1	Visual 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.		X			For flat-panel (direct view) displays: - The FOV must be continuous and free of physical obstructions or viewing plane discontinuities (i.e. Panel joints) as measured from the training pilot's eye-point. - The visual horizon must be continuously aligned across all adjoining panels and with and respond in a synchronized manner to pilot inputs. 30° vertical field of view may be insufficient to meet the requirements of the visual ground segment (if required).
		Visual display providing each pilot with a minimum of 150° horizontal and 40° vertical continuous field of view.					X	X	- 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).

Appendix E3 – Aeroplane – Non-Type-Specific FTD –Subjective Evaluation

Table E3A – Aeroplane Type-Specific FTD - Functions and Subjective Tests – Operations Tasks

Table E3a – Aeroplane Non-Type-Specific FTD - Subjective Requirements						
Entry #	Functions and Subjective Tests	Level		Qualification		Comment
		1	2	MCC	IPC	
1. Preparation for flight.						
1.a	Pre-flight. Note: - Accomplish a functions check of all switches, indicators, systems, and equipment at all crew members' and instructors' stations and determine that:					
1.a.2	The flight deck design and functions may be generic, but are aeroplane-like and recognizable as within a class of aeroplanes.	X		X		
1.a.3	The flight deck design and functions represent those of the simulated aeroplanes or set of aeroplanes.		X		X	
2. Surface operations (pre-flight).						
2.a	Engine start.					
2.a.1	Normal start.	X	X	X	X	
2.a.2	Alternate start procedures.		X	X		
2.a.3	Abnormal starts and shutdowns (hot start, hung start, tail pipe fire, etc.).		X	X		
2.b	Taxi.					
2.b.1	Pushback/powerback.	N/A	N/A			
2.b.2	Thrust response.	X	X	X	X	
2.b.3	Power lever friction.	X	X	X	X	
2.b.4	Ground handling.	X*	X	X	X	*If a visual is installed.
2.b.6	Low visibility (taxi route, signage, lighting, markings, etc).		X*	X	X	Applicable if low visibility training is intended. *Visual FOV must be 150x30 degrees minimum.
2.c	Brake operation:					
2.c.1	Normal, automatic and alternate/emergency operation.	X	X	X	X	
3. Take-off.						
3.a	Normal. Note. — Only applicable to those take-off tests relevant to the simulated aeroplane type or class. Conduct tests with limiting wind velocities, wind shear and with relevant system failures.					
3.a.1	Aeroplane/engine parameter relationships, including run-up.	X	X	X	X	
3.a.2	Nosewheel and rudder steering. (as applicable)	X*	X	X	X	*If visual is installed.
3.a.3	Crosswind (maximum demonstrated).	X	X	X	X	If visual is installed.
3.a.5	Low visibility take-off.		X	X*	X*	Applicable if low visibility training is intended. *Visual FOV must be 150x30 degrees minimum.
3.a.6	Landing gear, wing flap and leading edge device operation.	X	X	X	X	
3.a.7	Other.		X	X	X	As applicable if intended for training
3.b	Abnormal/emergency.					
3.b.1	Rejected take-off.			X	X	Consistently controllable within runway width to support approved use.

Table E3a – Aeroplane Non-Type-Specific FTD - Subjective Requirements

Entry #	Functions and Subjective Tests	Level		Qualification		Comment
		1	2	MCC	IPC	
3.b.4	Continued take-off with failure of most critical engine at most critical point.			X		Controllable to support procedural training.
3.b.5	Flight control system failures, reconfiguration modes, manual reversion and associated handling.			X		As applicable to systems installed.
4. Climb.						
4.a	Normal.	X	X	X	X	
4.b	One or more engine(s) inoperative.		X	X	X	
5. Cruise.						
5.a	Performance characteristics (speed versus power, configuration, and attitude).					
5.a.1	Straight and level flight.	X	X	X	X	
5.a.2	Change of airspeed.	X	X	X	X	
5.a.3	High-altitude handling.			X		
5.a.5	Overspeed warning (in excess of V _{mo} or M _{mo}).			X	X	
5.a.7	Other. <i>As applicable to intended additional approved training</i>					
5.b	Manoeuvres.					
5.b.1	High angle of attack, approach to stalls, stall warning, buffet, and g-break (take-off, cruise, approach, and landing configuration).	X	X	X	X	
5.b.2	Slow flight.	X	X	X	X	
5.b.3	Spin.					
5.b.4	Flight envelope protection (high AOA, bank limit, overspeed, etc.).			X	X	As applicable
5.b.6	Normal and standard rate turns.	X	X	X	X	
5.b.7	Steep turns.	X	X	X	X	
5.b.8	Performance turn.	X	X	X	X	
5.b.9	In-flight engine shutdown and restart (assisted and windmill).		X	X	X	As applicable
5.b.10	Manoeuvring with one or more engines inoperative.		X	X	X	As applicable
5.b.11	Specific flight characteristics (e.g. direct lift control).			X		
5.b.12	Flight control system failures, reconfiguration modes, manual reversion and associated handling.		X	X	X	As applicable
5.b.13	Gliding to a forced landing.		X	X		
5.b.14a	Visual resolution and FSTD handling and performance for the following: – Terrain accuracy for forced landing area selection; – Terrain accuracy for VFR Navigation; – Eights on pylons (visual resolution); – Turns about a point. – S-turns about a road or section line		X			As applicable and approved for use
5.b.15	Other. <i>As applicable to intended additional approved training</i>		X			
6. Descent.						
6.a	Normal.	X	X	X	X	
6.b	Maximum rate/emergency (clean, with speedbrakes, etc.).	X	X	X		As applicable
6.c	With autopilot.	X	X	X	X	As applicable
6.d	Flight control system failures, reconfiguration modes, manual reversion and associated handling.			X		As applicable
6.e	Other. <i>As applicable to intended additional approved training</i>	X	X	X	X	

Table E3a – Aeroplane Non-Type-Specific FTD - Subjective Requirements

Entry #	Functions and Subjective Tests	Level		Qualification		Comment
		1	2	MCC	IPC	
7. Instrument approaches and landing. (As applicable)						
<i>Note. — Only applicable to instrument approach and landing tests relevant to the simulated aeroplane set / class or as required for approved use. Conduct tests using limiting wind velocities, wind shear (except for the CAT II and III precision approaches) and with relevant system failures.</i>						
7.a	Precision approach.					
7.a.1	CAT I published approaches.					
7.a.1.a	– Manual approach with/without flight director including landing.	X	X	X	X	
7.a.1.b	– Autopilot coupled approach and manual landing.		X	X	X	
7.a.1.c	– Autopilot coupled approach, engine(s) inoperative.		X	X	X	
7.a.1.d	– Manual approach, engine(s) inoperative.	X	X	X	X	
7.a.2	Autopilot coupled approach (to a landing or to a go-around)		X	X	X	
7.a.3	GBAS, all engine(s) operating and with one or more engine(s) inoperative.		X	X	X	
7.b	Non-precision approach. (As applicable)					
7.b.1	Surveillance radar approach, all engine(s) operating and with one or more engine(s) inoperative.	X	X	X	X	
7.b.2	NDB approach, all engine(s) operating and with one or more engine(s) inoperative.	X	X	X	X	
7.b.3	VOR, VOR/DME, TACAN approach, all engines(s) operating and with one or more engine(s) inoperative.	X	X	X	X	
7.b.4	RNAV / RNP / GNSS (RNP at nominal and minimum authorized temperatures) approach, all engine(s) operating and with one or more engine(s) inoperative.	X	X	X	X	Must include a capability to activate integrity loss indications
7.b.5	ILS (LOC), all engine(s) operating and with one or more engine(s) inoperative.	X	X	X	X	
7.b.6	ILS offset localizer approach, all engine(s) operating and with one or more engine(s) inoperative.	X	X	X	X	
7.c	Approach procedures with vertical guidance (APV), e.g. SBAS, flight path vector.					
7.c.1	APV/baro-VNAV approach, all engine(s) operating and with one or more engine(s) inoperative.	X	X	X	X	Must include a capability to activate of integrity loss indications
7.c.2	Area navigation (RNAV) approach procedures based on SBAS, all engine(s) operating and with one or more engine(s) inoperative.	X	X	X	X	
8. Visual approaches (segment) and landings. (As applicable)						
8.a	Manoeuvring, normal approach and landing all engines operating, with and without visual and navigational approach aid guidance.		X	X	X	
8.b	Approach and landing with one or more engine(s) inoperative.		X	X	X	
8.c	Operation of landing gear, flap/slats and speedbrakes (normal and abnormal).		X	X	X	
8.d	Approach and landing with crosswind (maximum demonstrated crosswind component).		X	X	X	
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).		X	X	X	
8.f	Approach and landing with standby (minimum) electrical/hydraulic power.			X		If abnormal operation is designated and approved for use.

Table E3a – Aeroplane Non-Type-Specific FTD - Subjective Requirements

Entry #	Functions and Subjective Tests	Level		Qualification		Comment
		1	2	MCC	IPC	
8.g	Approach and landing from circling conditions (circling approach). <i>Note. — 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. 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.</i>		X	X		Procedural training only. Visual FOV must be 150x30 degrees minimum.
8.h	Approach and landing from visual traffic pattern.		X	X	X	
8.i	Approach and landing from non-precision approach.		X	X	X	
8.j	Approach and landing from precision approach.		X	X	X	
8.k	Other. <i>Note: An FTD with a visual system permitting a special approach procedure in accordance with the CARs, may be approved for that particular approach procedure.</i>		X	X	X	
9. Missed Approach.						
9.a	All engines, manual and autopilot.	X	X	X	X	
9.b	Engine(s) inoperative, manual and autopilot.	X	X	X	X	
9.c	Rejected landing.	X	X	X	X	
10. Surface operations (landing, after-landing and post-flight).						
10.a	Landing roll and taxi. (As applicable)					
10.a.1	HUD/EFVS.			X	X	
10.a.2	Spoiler operation.		X	X	X	
10.a.3	Reverse thrust operation.		X	X	X	
10.a.4	Directional control and ground handling, both with and without reverse thrust.	X	X	X	X	
10.a.6	Brake and anti-skid operation with dry conditions.	X	X	X	X	If visual is installed.
10.b	Engine shutdown and parking.					
10.b.1	Engine and systems operation.	X	X	X	X	
10.b.2	Parking brake operation.		X	X	X	
10.b.3	Other. <i>As applicable to intended additional approved training</i>	X	X	X	X	
11. Any flight phase						
11.a	Aeroplane and engine systems operation (Subject to evaluation if installed or required for approved use).					
11.a.1	Air conditioning and pressurisation (Environmental Control System).			X		
11.a.2	De-icing/anti-icing.		X	X	X	
11.a.3	Auxiliary engine/auxiliary power unit (APU).			X		
11.a.4	Communications.	X	X	X	X	
11.a.5	Electrical.	X	X	X	X	
11.a.6	Fire and smoke detection and suppression.			X		

Table E3a – Aeroplane Non-Type-Specific FTD - Subjective Requirements

Entry #	Functions and Subjective Tests	Level		Qualification		Comment
		1	2	MCC	IPC	
11.a.7	Flight controls (primary and secondary).	X	X	X	X	
11.a.8	Fuel and oil.	X	X	X	X	
11.a.9	Hydraulic.	X	X	X		
11.a.10	Pneumatic.	X	X	X		
11.a.11	Landing gear.	X	X	X	X	
11.a.12	Oxygen.			X		
11.a.13	Engine.	X	X	X	X	
11.a.14	Airborne radar.		X	X		
11.a.15	Autopilot and flight director.	X	X	X	X	
11.a.16	Terrain awareness warning systems and collision avoidance systems (e.g. EGPWS, GPWS, TCAS).	X	X	X		
11.a.17	Flight control computers including stability and control augmentation.		X	X		
11.a.18	Flight display systems.	X	X	X	X	
11.a.19	Flight management systems.	X	X	X	X	
11.a.20	Head-up displays (including EFVS, if appropriate).		X	X		
11.a.21	Navigation systems.	X	X	X	X	
11.a.22	Stall warning/avoidance.	X	X	X	X	
11.a.28	Other.					
11.b	Airborne procedures.					
11.b.1	Holding.	X	X	X	X	
11.b.2	Air hazard avoidance (traffic, weather, including visual correlation).		X	X		If installed
12. Visual System. This section applies to real-world airports models designated by the sponsor for approved use, which will be used to complete the functions and subjective tests described in this Appendix. The airports should service the aeroplane type being simulated, be used regularly in the training programme(s) and, as applicable. However, if the requirement for device level allows, the sponsor may present models for use during the initial qualification which do not fully replicate any particular airport (fictitious airport). During recurrent evaluations the evaluator may select any visual scene used in the operator's training programme(s) for completion of the functions and subjective tests, provided these 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. – A minimum of one (1) generic airport model to be consistent with published data used for aeroplane operations. This model should be acceptable to the NSEP and selectable from the IOS.	X*	X	X		Sponsor must designate real –world scenes for qualification prior to the initial evaluation. *If a visual is installed.
	– A minimum of three (3) 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.				X	

Table E3a – Aeroplane Non-Type-Specific FTD - Subjective Requirements

Entry #	Functions and Subjective Tests	Level		Qualification		Comment
		1	2	MCC	IPC	
12.a.2	Visual scene fidelity. – A generic or fictitious airport visual scene with sufficient fidelity for the aircrew to successfully accomplish take-offs, approaches, and landings.	X				If visual system is installed
	– The “non-designated” visual scenes must have sufficient fidelity for the aircrew to visually identify the airport; determine the position of the simulated aeroplane; successfully accomplish take-offs, approaches, and landings; and manoeuvre around the airport on the ground as necessary.		X	X		For non-designated scenes
	– The “designated” visual scenes should correctly represent the parts of the airport and its surroundings used in training or checking.		X	X	X	For designated scenes
12.a.3	Runways and taxiways. – Generic runways and taxiways.	X				If visual system is installed
	– Representative runways and taxiways.		X	X		For non-designated scenes
	– The airport runways and taxiways.		X	X	X	For designated scenes
12.a.4	Runway threshold elevations and locations should be modelled to provide correlation with aeroplane systems (e.g. HUD, GPS, compass, altimeter).	X	X	X	X	
12.a.5	Runway surface and markings for each “in-use” runway should include the following, if appropriate: – Threshold markings. – Runway numbers. – Touchdown zone markings. – Edge markings. – Centre line markings. – Windsock that gives appropriate wind cues.	X	X	X	X	The feature, if required, should be representative for “designated scenes” and generic for “non-designated” scenes.
	– Fixed distance markings.		X	X	X	
	– Signs at intersecting runways and taxiways.			X	X	
12.a.6	Runway lighting of appropriate colours, directionality, behaviour and spacing for the “in-use” runway including the following: – Threshold lights. – Edge lights. – End lights. – Centre line lights. – Touchdown zone lights. – Lead-off lights. – Appropriate visual landing aid(s) for that runway. – Appropriate approach lighting system for that runway.	X	X	X	X	The feature, if required, should be representative for “designated scenes” and generic for “non-designated” scenes.
	– Representative airport buildings, structures and lighting.		X		X	
12.a.7	Taxiway surface and markings (associated with each “in-use” runway): – Centre line markings. – Runway holding position markings.	X	X	X	X	The feature, if required, should be representative for “designated scenes” and generic for “non-designated” scenes.
	– Edge markings		X	X	X	
	– ILS critical area markings.					

Table E3a – Aeroplane Non-Type-Specific FTD - Subjective Requirements

Entry #	Functions and Subjective Tests	Level		Qualification		Comment
		1	2	MCC	IPC	
	– A including 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. The designated runway and taxi routing should be consistent with that airport for operations in low visibilities.		X	X		Low visibility taxi route applies only if low visibility procedural training is intended.
12.a.8	Taxiway lighting of appropriate colours, directionality, behaviour and spacing (For each “in-use” runway): – Edge lights. – Centre line lights. – Runway holding position and ILS critical area lights.	X	X	X	X	The feature, if required, should be representative for “designated scenes” and generic for “non-designated” scenes.
12.a.9	Required visual model correlation with other aspects of the airport environment simulation. – The airport model should be properly aligned with the navigational aids that are associated with operations at the runway “in-use”.	X	X	X	X	
12.a.10	Airport buildings, structures and lighting. – Representative airport buildings, structures and lighting.		X		X	
	– Generic airport buildings, structures and lighting.	X		X		
12.a.11	Terrain and obstacles – Representative depiction of terrain and obstacles within 46 km (25 NM) of the reference airport.		X	X		
12.a.12	Significant, identifiable natural and cultural features. – Representative depiction of significant and identifiable natural and cultural features within 46 km (25 NM) of the reference airport. (See Note) – Representative moving airborne traffic (including the capability to present air hazards – e.g. airborne traffic on a possible collision course). (if installed)		X	X		Note: This refers to natural and cultural features typically used for pilot orientation in flight.
12.b	Visual scene management. Airport runway, approach and taxiway lighting and cultural 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.	X	X	X	X	
12.c	Visual feature recognition. <i>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-degree glide slope in suitable simulated meteorological conditions. For circling approaches, all tests below apply both to the runway used for the initial approach and to the runway of intended landing.</i>					
	– Runway definition, strobe lights, approach lights, and runway edge white lights from 8 km (5 sm) of the runway threshold. – Visual approach aids lights from 4.8 km (3 sm) of the runway threshold. – Runway centre line lights and taxiway definition from 4.8 km (3 sm). – Threshold lights and touchdown zone lights from 3.2 km (2 sm). – For circling approaches, the runway of intended landing and associated lighting should fade into view in a non-distracting manner.	X	X	X	X	

Table E3a – Aeroplane Non-Type-Specific FTD - Subjective Requirements

Entry #	Functions and Subjective Tests	Level		Qualification		Comment
		1	2	MCC	IPC	
12.d	Selectable airport visual scene capability for:					
	– Night.				X	
	– Twilight.				X	
	– Day.	X	X	X	X	
12.e	Correlation with aeroplane and associated equipment.					
12.e.1	Visual cues to relate to actual aeroplane responses.	X	X	X	X	
12.e.2	Visual cues during take-off, approach and landing:					
	– Visual cues to assess sink rate and depth perception during landings.					
	– Visual cueing sufficient to support changes in approach path by using runway perspective.	X	X	X	X	
	– 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.	X	X	X	X	
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).		X	X		If installed
12.f	Scene quality.					
	– Surfaces and textural cues should not create distracting quantization (aliasing).					
	– System capable of portraying full colour realistic textural cues.	X	X	X	X	
	– The system light points should be free from distracting jitter, smearing or streaking.					
	– System capable of providing light point perspective growth.					
12.g	Environmental effects. 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.		X	X	X	
14. Sound system.						
14.a	Significant aeroplane noises perceptible to the pilot during normal operations, such as engine, propeller, flaps, gear, anti-skid, spoiler extension/retraction, thrust reverser to a comparable level of that found in the aeroplane.	X	X	X	X	
14.b	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 malfunction.	X	X	X	X	
14.c	Sound of a crash when the FSTD is landed in excess of limitations.	X	X	X	X	
15. Special effects.						
15.a	Effects of airframe and engine icing.		X	X	X	
16. Instructor Operating Station.						
16.a	Repositions:					
	– Ramp/gate.	X	X	X	X	repositions should be in-trim at the appropriate speed and configuration for the point
	– Take-off.					
	– Approach.					

Table E3a – Aeroplane Non-Type-Specific FTD - Subjective Requirements

Entry #	Functions and Subjective Tests	Level		Qualification		Comment
		1	2	MCC	IPC	
16.b	Resets: – System. – Temperature. – Fluids and agents.	X	X	X	X	
16.c	Environment:					
16.c.1	Weather pre-sets: – Unlimited, CAVOK, VFR, non-precision, precision (CAT I), (if appropriate).		X		X	
	– Unlimited, CAVOK, VFR.	X		X		
16.c.2	Visual effects: – Time of day (day, dusk, night); clouds (bases, tops) in feet; visibility in statute miles and RVR in feet. Note: <i>IOS inputs should be tuned as follows:</i> – <i>Visibility - to see the runway threshold environment (no lights),</i> – <i>RVR - to attain visual contact with runway threshold lights.</i>	X	X	X	X	
16.c.3	Wind: – Surface. – Turbulence. – Surface temperature – Atmospheric pressure (QNH).	X	X	X	X	
16.d	– Airport: – Active runway selection. – Airport lighting.	X	X	X	X	
16.e	Aeroplane configuration (fuel, weight, cg, etc.).	X	X	X	X	
16.f	FMS - reloading of programmed data unless precluded by installed equipment.	X	X	X	X	
16.g	Plotting and recording (take-off and approach).		X	X	X	
16.h	Malfunctions (inserting and removing).	X	X	X	X	

Appendix F1 – Rotorcraft Non-Type-Specific FTD – General Simulator Requirements.

12. This Appendix describes the general requirements for qualifying Level 1 and 2 non-type-specific rotorcraft FTDs. The sponsor should also consult the objectives tests in Table F2A and the functions and subjective tests listed in Table F3A to determine the complete requirements for a specific level FTD.
13. The general simulator requirements are divided into the following categories:
 - h. General Flight Deck Configuration.
 - i. Programming.
 - j. Equipment Operation.
 - k. Equipment and Facilities for Instructor/Evaluator Functions.
 - l. Motion System.
 - m. Visual System.
 - n. Sound System.
14. Table F1A provides the standards for the General FTD Requirements.
15. Table F1B provides the operational tasks that the sponsor will examine to determine whether the FTD satisfactorily meets the requirements for flight crew training, testing, and experience.

Table F1A - Rotorcraft - Non-Type Specific FTD – General Requirement

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.				
Item #	Requirement	Level		Comment
		1	2	
1.0 COCKPIT LAYOUT AND STRUCTURE				
1.1	An open, enclosed, or perceived to be enclosed, cockpit, excluding distraction, which will represent that of a group of helicopters to support the intended use. <u>Cockpit (simulated area):</u> An open, enclosed or perceived to be enclosed cockpit area with helicopter-like primary and secondary flight controls, engine and rotor controls, equipment, systems, instruments, panels and associated controls sufficient for the training tasks to be accomplished, assembled in a spatially representative manner resembling that of the group of helicopters being simulated. The enclosure, if any, does not need to enclose the instructor station. <u>Instruments, panels and cockpit equipment:</u> The flight instrument panel(s) position and crew member seats should provide the crew member(s) with a representative posture at the controls and representative design eye position.	X	• 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 helicopter used for training. • “Helicopter-like” controls, instruments and equipment means as for the group of helicopters being simulated. • Only those circuit breakers used in a normal, abnormal or emergency procedure need to be presented, simulated in a helicopter-like form, and be functionally accurate. • The assembled components should be compatible and function in a cohesive manner. • The use of electronically displayed images with or without physical overlay or masking is acceptable. • Operable controls should be incorporated if pilot input is required during training events. The instruments displayed should be free of quantization (stepping). • If the FSTD is convertible, some may have to be changed for some conversions. • Touch screen panels: For CRM training, touch screen areas operated by both crew members should be capable of recognizing multiple contacts (multi-touch technology) in order to enable the crew to work simultaneously, e.g. on an inter-seat console or overhead area.	

	An enclosed or perceived to be enclosed cockpit, excluding distraction and representative of a group of helicopters to support the intended use. <u>Cockpit (simulated area):</u> An enclosed or perceived to be enclosed, spatially representative cockpit representing a group of helicopters and the configuration (including instrument panel layout) being simulated including representative: structure bulkheads and panels; primary and secondary flight controls; engine and rotor controls; circuit breakers; flight instruments; navigation, communications and similar use equipment; caution and warning systems; and all other equipment and systems with associated controls and observable cockpit indicators sufficient for the training events to be accomplished. <u>Instruments, panels and cockpit equipment:</u> The preceding should be properly located, functionally accurate and the technique, effort and direction required to manipulate them within the correct range of movement, as applicable, should be representative of those in the group of helicopters. <u>Window replication:</u> Windows and chin windows, if any, should be included. Window accessories may be omitted. <u>Enclosure:</u> The cockpit enclosure needs only to be representative of that in the group of helicopters being simulated. The enclosure needs only to extend to the aft end of the cockpit and does not need to enclose the instructor station. <u>Circuit breakers:</u> A representative circuit breaker panel(s) should be presented (photographic reproductions are acceptable) and located in a spatially representative location(s).			• For FSTD purposes, the cockpit consists of all that space forward of a cross section of the cockpit at the most extreme aft setting of the flight crew members' seats or, if applicable, forward of that cross section immediately aft of additional crew member seats and/or required bulkheads. • If the FSTD is used for VFR training, it should be a representation of the group of helicopters and of the configuration (including instrument panel and glare shield layout) comparable to the actual helicopter used for flight training. • The use of electronically displayed images with physical overlay or masking for FSTD instruments and/or instrument panels is acceptable provided it incorporates operable controls representative of those in the helicopter. The instruments displayed should be free of quantization (stepping). • A device for NVG training should have cockpit glazing (reflection) if the helicopter has such characteristics. • With the requirement for only a spatially representative cockpit, the physical dimensions of the enclosure may be acceptable to simulate more than one group of helicopters in a convertible FSTD. Each FSTD conversion should be representative of the group of helicopters being simulated which may require some controls, instruments, panels, masking, etc., to be changed for some conversions. • Only those circuit breakers used in a normal, abnormal or emergency procedure need to be simulated, in a group representative form, and be functionally accurate.
1.2	SEATING	X		

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Item #	Requirement	Level		Comment
		1	2	
	Flight 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 group of helicopters.			• Helicopter cockpit observer seats are not considered to be additional flight crew member duty stations and may be omitted.
	All flight crew member seats should represent those in the helicopter being simulated. They should afford the capability for the occupants to be able to achieve the design eye reference position established for the group of helicopters being simulated.		X	
	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.	X	X	• These seats need not be a replica of an aircraft seat and may be as simple as an office chair placed in an appropriate position.
1.3	LIGHTING Lighting environment for panels and instruments should be sufficient for the intended use.	X	X	• Back-lighted panels and instruments may be installed but are not required.
2.0 FLIGHT MODEL				
2.1	Generic flight/engine model of a group of helicopters to support the intended use. This should include effects in the change of gross mass and centre of gravity. A flight dynamics model helicopter-like (may be generic), including aerodynamic and engine modelling, that accounts for various combinations of airspeed and power normally encountered in flight including the effect of change in helicopter attitude, altitude, temperature, mass, centre of gravity location and configuration.	X		

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Item #	Requirement	Level		Comment
		1	2	
	Aerodynamic and engine modelling should be representative of the appropriate group of helicopters according to design characteristics that affect the aerodynamic model. A flight dynamics model, including aerodynamic and engine modelling, that accounts for various combinations of airspeed and power normally encountered in flight including the effect of change in helicopter attitude, altitude, temperature, mass, centre of gravity location and configuration.		X	It includes rotor design and configuration (teetering head, semi rigid, fully articulated and appropriate rotor direction of rotation), centre of gravity location, mass, altitude and temperature to include vortex ring [settling with power] and retreating blade stall.
2.2	AERODYNAMIC MODEL Generic aerodynamics modelling, helicopter-like, to support the intended use, that may include ground effect, aerodynamic interference effects between the rotor wake and fuselage, influence of the rotor on control and stabilization systems, and representations of non-linearity due to sideslip.	X		Aerodynamic data do not need to be necessarily based on flight test data.
	Aerodynamics modelling, helicopter-like, derived from and appropriate to a group of helicopters to support the intended use and including ground effect, effects of airframe and rotor icing (if applicable), aerodynamic interference effects between the rotor wake and fuselage, influence of the rotor on control and stabilization systems, and representations of non-linearity due to sideslip, vortex ring [settling with power] and retreating blade stall.		X	Validation flight test data, tailored to the representation of the group of helicopters should be used as the basis for flight and performance characteristics.
2.3	MASS PROPERTIES A generic, helicopter-like, mass properties model to support the intended use and including mass, centre of gravity and moments of inertia as a function of payload and fuel loading should be implemented.	X	X	
3.0 GROUND REACTION AND HANDLING CHARACTERISTICS				
3.1	Generic ground reaction model and ground taxiing characteristics that are helicopter-like but not specific to model, type or variant.	X	X	

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Item #	Requirement	Level		Comment
		1	2	
3.2	LANDING SURFACE CONDITIONS Stopping and directional control forces for dry landing surface conditions.	X	X	
4.0 ROTORCRAFT SYSTEMS				
4.1	NORMAL, ABNORMAL AND EMERGENCY SYSTEMS OPERATION The systems should be operative to the extent that it should be possible to perform normal, abnormal, and emergency operations as required for the approved training programme.	X		Once activated, proper systems operations should result from the system management by the crew member and not require any further input from the instructor's controls.
	Helicopter systems represented in the FSTD must simulate representative systems operation of a helicopter or group of helicopters including system interdependencies, both on the ground and in flight. Systems must be operative to the extent that applicable normal, abnormal, and emergency operating procedures included in the operator's training programmes can be accomplished.		X	- Helicopter system operation must be predicated on, and traceable to, the system data supplied by the helicopter manufacturer, original equipment manufacturer or alternative approved data for the helicopter system or component, e.g. medium twin engine helicopter; it does not have to be type-specific. - Once activated, proper systems operation must result from system management by the crew member and not require any further input from the instructor's controls.
4.2	INSTRUMENT INDICATIONS All relevant instrument indications involved in the helicopter or group of helicopters being simulated should automatically respond to attitude changes of the helicopter, pilot inputs or changes in system status.	X		Numerical values should be presented in the appropriate units.
	All relevant instrument indications involved in the helicopter or group of helicopters being simulated should automatically respond to attitude changes of the helicopter, pilot inputs or changes in system status, as well as to atmospheric disturbance and also respond to effects resulting from icing.		X	

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Item #	Requirement	Level		Comment
		1	2	
4.3	COMMUNICATIONS, NAVIGATION, CAUTION AND WARNING SYSTEMS Communications equipment and aural cues fed through headsets, to support the intended use.	X		
	Communications, navigation, caution and warning equipment, including audio warnings and other aural cues fed through headsets, corresponding to that typically installed in a representative helicopter simulation should operate within the tolerances prescribed for the applicable airborne equipment.		X	• Operation characteristics include any specific behaviour of the equipment being simulated, e.g. dependencies between two or more simulated systems in case of malfunctions or special operating limitations of general purpose equipment resulting from the integration in the helicopter type being simulated.
4.4	ANTI-ICING SYSTEMS Anti-icing systems corresponding to those typically installed in that helicopter or group of helicopters should operate.	X	X	• Simplified airframe and engine, including engine induction and pitot-static system, icing models with corresponding performance degradations due to icing should be provided. Effects of anti-icing/de-icing systems activation should also be present.
5.0 FLIGHT CONTROLS				
5.1	FLIGHT CONTROLS AND FORCES Control forces and control travel and resulting effect should broadly correspond to the group of helicopters being simulated.	X		• Active force feedback not required. Control forces produced by a passive arrangement are acceptable.
	Representative of a group of helicopters (e.g. pedal position with rotor direction), but it does not have to be type-specific.		X	• Active force feedback required if appropriate to the helicopter installation.
5.2	CONTROL SYSTEM OPERATION Control systems should allow basic helicopter operation with appropriate cockpit indications.	X		Test required.

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Item #	Requirement	Level		Comment
		1	2	
	Control systems should replicate the group of helicopters 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.		X	Test required.
6.0 SOUND SYSTEM				
6.1	Sounds due to engine(s), transmission(s) and rotor(s) should be available, helicopter-like but not specific to model, type or variant.	X	X	• Environmental sounds are not required. However, if present, they should be coordinated with the simulated weather.
6.2	The sound of a crash when the simulated helicopter exceeds limitations.	X	X	
6.3	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	X	X	• Sound not required to be directional.

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.				
Item #	Requirement	Level		Comment
		1	2	
7.0 VISUAL SYSTEM				
7.1	DISPLAY An FOV of at least 45 degrees horizontally and 30 degrees vertically for each pilot simultaneously. The image should be aligned to the pilot flying. The misalignment observed by the non-flying pilot should not exceed 20 degrees. Where the rotor blade tip path would be visible within the above FOV, it should be appropriately depicted. 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.	X		• The horizontal and vertical FOV distribution may be adjusted to cover the particular helicopter configuration. • The 20-degrees limitation may be extended to 24 degrees where practical considerations, such as dome size on large dual cockpit helicopters, make the increase necessary, provided that the FSTD operator can prove to the satisfaction of the qualifying authority that the quality of training will not be compromised.
	A continuous FOV of at least 180 degrees horizontally and 45 degrees vertically for each pilot simultaneously. The image should be aligned to the pilot flying. The misalignment observed by the non-flying pilot should not exceed 20 degrees. The vertical FOV should be distributed such that 15 degrees is above the horizon and 30 degrees is below. Where the rotor blade tip path would be visible within the above FOV, it should be appropriately depicted. The system should be free from optical discontinuities and artefacts that create non-realistic cues.		X	• The horizontal and vertical FOV distribution may be adjusted to cover the particular helicopter configuration. • An SOC is required and should explain the geometry of the installation. • Joins in the display surface are allowed where required for transportation of mobile simulators, but should be minimized. • The 20-degrees limitation may be extended to 24 degrees where practical considerations, such as dome size on large dual cockpit helicopters, make the increase necessary, provided that the FSTD operator can prove to the satisfaction of the qualifying authority that the quality of training will not be compromised.
7.2	SURFACE RESOLUTION — Surface 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.	X		• An SOC is required containing calculations confirming the resolution.

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Item #	Requirement	Level		Comment
		1	2	
	2 arc minutes in the visual display used on a scene from the pilot's eyepoint.		X	
7.3	LIGHT-POINT SIZE — not greater than: 8 arc minutes.	X		An SOC is required confirming that the test pattern represents lights used for airfield lighting.
	5 arc minutes.		X	
7.4	SURFACE CONTRAST RATIO — adequate for the intended use — Not less than 4:1	X		
	Not less than 8:1.		X	
7.5	LIGHT-POINT CONTRAST RATIO — Light-point contrast ratio sufficient to identify light — Not less than 8:1.	X		
	Not less than 25:1.		X	
7.6	SYSTEM BRIGHTNESS Sufficient to support the intended use.	X		
	System brightness should be demonstrated using a raster drawn test pattern, be sufficient to appear like an average day and maintain contrast ratio. The surface brightness should not be less than 20 cd/m² (5.8 ft-lamberts).		X	
7.7	BLACK LEVEL AND SEQUENTIAL CONTRAST Suitable to support the intended use.	X		An explanation should be provided in cases where the test is not considered relevant to the display type.
	The black level and sequential contrast need to be measured to determine that they are sufficient for training in all times of day.		X	

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Item #	Requirement	Level		Comment
		1	2	
7.8	MOTION BLUR	X	X	An explanation should be provided in cases where the test is not considered relevant to the display type.
	- Suitable to support the intended use. - Tests are required to determine the amount of motion blur that is typical of certain types of display equipment. A test should be provided that demonstrates the amount of blurring at a predefined rate of movement across the image.			
7.9	SPECKLE TEST	X	X	- An explanation should be provided in cases where the test is not considered relevant to the display type. - This test normally only applies to projectors using light sources with some degree of coherence.
	- Suitable to support the intended use. - A test is required to determine that the speckle typical of laser-based displays is below a distracting level.			
7.10-12	Reserved			
7.13	ROTOR DOWNWASH EFFECTS The system should provide the ability to present the effect of re-circulating dust, water vapour, or snow conditions that develops as a result of rotor downwash. The effect is to be correlated with the surface type under the helicopter.	N/A	X	
8.0 MOTION				

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Item #	Requirement	Level		Comment
		1	2	
8.1	MOTION CUES The FSTD should have at least a vibration cueing system for characteristic helicopter vibrations noted at the pilot station(s) and should provide vibration and buffet effects programming to include the following: 1) Primary main rotor speed and disk loading vibration effects; 2) Buffet due to translational lift and effect of speed changes; and 3) Buffets due to abnormal system conditions.	N/A	X	Fundamental helicopter vibration cues, to include primary main rotor speed and disc loading cues, translational lift and speed change cues (acceleration and deceleration), and a general abnormal vibration cue.
9.0	Reserved			
10.0 ENVIRONMENT				
10.1	NAVIGATION DATABASE - sufficient to support simulated helicopter systems for real world operations.	X	X	Navigational data with the corresponding approach facilities to support the intended use, such as GPS, VOR, DME, ILS, NDB, etc.
10.2	MINIMUM AIRPORT/HELIPORT REQUIREMENT - Complete navigation database for at least one airport and/or heliport including regular updates.	X	X	- Regular updates means navigation database updates as mandated by the NAA. - If GPS approaches are available at these airports or heliports, they should be supported if the helicopter is so equipped.
10.3	INSTRUCTOR CONTROLS - Instructor controls of internal and external navigational aids.	X	X	e.g. helicopter ILS glideslope receiver failure compared to ground facility glideslope failure.
10.4	ARRIVAL/DEPARTURE FEATURES - Navigational data with all the corresponding standard arrival and departure procedures.	X	X	
10.5	NAVIGATION AIDS RANGE - Navigational data with all the corresponding standard arrival and departure procedures.	X	X	Navigation aids should correspond to the real world and be usable within range without restriction unless intentionally reduced due to terrain or other obstructions.

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.				
Item #	Requirement	Level		Comment
		1	2	
11.0 ATMOSPHERE AND WEATHER				
11.1	STANDARD ATMOSPHERE - Simulation of the standard representative atmosphere including instructor control over key parameters.			
11.2	WEATHER EFFECTS Smooth transition between weather effects should be provided. The following weather effects as observed on the visual system should be simulated and respective instructor controls provided: A cloud layer with adjustable base and top;	X		- A subjective test is required. - The intent of this capability is to demonstrate transition from VMC to IMC.
	Multiple cloud layers with adjustable bases, tops, sky coverage and scud effect;		X	

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Item #	Requirement	Level		Comment
		1	2	
	Storm cells activation and/or deactivation;		X	
	Visibility and RVR.	X		
	Visibility and RVR, including fog effects;		X	• An objective test is required.
	Effects of own aircraft external lighting;		X	
	Surface contaminants and own aircraft downwash and recirculation effect;		X	
	Precipitation effects (rain, hail, snow);		X	
	Variable precipitation effects (rain, hail, snow);		X	
	Gradual visibility changes entering and breaking out of cloud.		X	
11.3	INSTRUCTOR CONTROLS The following features should be simulated, with appropriate instructor controls provided:			• A subjective test is required.
	Wind speed and direction;	X		
	Surface wind speed, direction and gusts;		X	
	Wind speed and direction;	X		
	Intermediate and high altitude wind speed And direction;		X	
	Thunderstorms and microbursts;		X	

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Item #	Requirement	Level		Comment
		1	2	
	Turbulence.	X	X	
12.0 LANDING AREAS AND TERRAIN				
12.1	The system should include a generic airport with a helicopter landing area available.	X		
	A minimum of one (1) airport or heliport and one (1) helicopter landing area model. The airport or heliport and the helicopter landing area may be contained within the same model. If this option is selected, the approach path to the airport runway(s) and the approach path to the helicopter landing area should be different.		X	- The fidelity of the visual scene should be sufficient for the aircrew to: visually identify the airport and/or helicopter landing area; determine the position of the simulated helicopter within the visual scene; successfully accomplish take-offs, approaches and landings; and manoeuvre around the airport on the ground, or in hover taxi, as necessary. - The airport, heliport or helicopter landing area may be either fictional or real-world.
12.2	VISUAL ENVIRONMENT DETAIL Textured surfaces to assess sink rate and enable depth perception during take-off and landing should be provided.	X		
	Visual cues to assess sink rate and enable depth perception during take-off and landing should be provided. Highly detailed and accurate surface depiction of the terrain surface within an approximate area from 400 m (1/4 sm) before to 400 m (1/4 sm) beyond the runway approach end with a total width of approximately 400 m (1/4 sm) including the width of the runway.		X	

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Item #	Requirement	Level		Comment
		1	2	
12.3	SCENE CONTENT The visual system should be capable of producing, as a minimum, scene content comparable in detail to that produced by 6 000 polygons and 1 000 visible light-points for night, dusk and day scenes for the entire visual system.	X		
	The visual system should be capable of producing, as a minimum, scene content comparable in detail to that produced by 6 000 polygons and 5 000 visible light-points for night, dusk and day scenes for the entire visual system.		X	
12.4	SPECIAL EFFECTS The following effects should be capable of being displayed: • Downwash effects including brownout and whiteout; • Sea states including the resulting movement of ships used for deck landings; • Effects of wind lanes on water surface; and • Ground static and moving traffic and airborne traffic capable of conflicting with own aircraft.	N/A	X	
14.0 ADDITIONAL TECHNICAL REQUIREMENTS				
14.1	INSTRUCTOR OPERATING STATION The instructor operating station should provide an adequate view of the pilots' panels and forward windows.	X	X	

Table F1A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – GENERAL REQUIREMENTS.

Item #	Requirement	Level		Comment
		1	2	
14.2	INSTRUCTOR CONTROLS The instructor operating station should have controls that enable the instructor to control all required system variables and insert all abnormal or emergency conditions into the simulated helicopter systems, as appropriate. The instructor operating station should have controls for all environmental effects expected to be available at the instructor operating station (e.g. clouds, visibility, icing, precipitation, temperature, storm cells, and wind speed and direction).	X	X	
14.3	COMPUTER CAPACITY 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.	X	X	
14.4	TESTING Validation testing of FSTD hardware and software to enable manual recurrent testing should be available.	X	X	• 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.
14.5	UPDATES TO FSTD HARDWARE AND SOFTWARE Timely permanent update of FSTD hardware and software should be conducted subsequent to helicopter modification where it affects training, sufficient for the qualification type sought.	X	X	
14.6	DAILY PRE-FLIGHT DOCUMENTATION Daily pre-flight documentation either in the daily log or in a location easily accessible for review is required.	X	X	
14.7	SYSTEM INTEGRATION - Transport delay: A transport delay test should be used to demonstrate that the FSTD system response does not exceed 120 ms.	X	X	An SOC is acceptable in lieu of testing, however, testing for initial evaluation may be required to verify the SOC if latency calculations in the SOC are close to tolerance.

Item #	Requirement	Level		Comment
		1	2	
14.8	RECORD, FREEZE AND PLAYBACK Record, freeze and playback capability.	X	X	

Table F2A – Rotorcraft – Non-Type Specific FTD – Objective Tests

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS							
Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
1. Performance							
<i>NOTE: All the one engine inoperative tests in this section are only applicable to multi-engine helicopters.</i>							
1.1	Engine Start Operations Steady State Idle and Operating RPM conditions.	Torque ± 3%. Rotor speed ± 1.5%.	Ground	Record both steady state idle and operating RPM conditions. May be a series of snapshot tests.	X	X	Data should be presented for both steady state idle and operating RPM conditions. It may be a snapshot test.
1.2	Takeoff <i>NOTE: When the speed range for the following tests is less than 40 knots, the applicable airspeed tolerance may be applied to either airspeed or ground speed, as appropriate.</i>						

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
1.2.1	All Engines	Airspeed $\pm$ 3 kts. Height $\pm$ 6.1 m (20 ft). Torque $\pm$ 3%. Rotor speed $\pm$ 1.5%. Pitch angle $\pm$ 2.5°. Roll angle $\pm$ 2°. Heading $\pm$ 2°.	Hover and Initial Segment of Climb.	Time history of take-off flight path as appropriate to helicopter model simulated and FSTD type. Take-off from hover IGE.	X	X	Record data to at least 61 m (200 ft) AGL/Vy whichever comes later
1.2.2	One Engine Inoperative continued takeoff.	Airspeed $\pm$ 3 kts. Height $\pm$ 6.1 m (20 ft). Torque $\pm$ 3%. Rotor Speed $\pm$ 1.5%. Pitch angle $\pm$ 2.5°. Roll angle $\pm$ 2°. Heading $\pm$ 2°.	Hover and Initial Segment of Climb.	Time history of take-off flight path as appropriate to helicopter model simulated.	X	X	Record data to at least 61 m (200 ft) AGL/Vy whichever comes later. This test corresponds to an open field CAT A take-off with an engine failure after TDP.

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
1.2.3	One Engine inoperative, rejected take off.	Airspeed ± 3 kts. Height ± 6.1 m (20 ft). Torque $\pm 3\%$. Rotor speed $\pm 1.5\%$. Pitch angle $\pm 2.5^\circ$. Roll angle $\pm 1.5^\circ$. Heading $\pm 2^\circ$. Distance: $\pm 7.5\%$ or ± 30 m (100 ft).	Ground, Takeoff.	Time history of take-off flight path as appropriate to helicopter model simulated.			Record data to at least 61 m (200 ft) AGL/Vy whichever comes later. This test corresponds to an open field CAT A take-off with an engine failure before TDP.
1.3	Hover Performance	Torque $\pm 3\%$. Pitch angle $\pm 1.5^\circ$. Roll angle $\pm 1.5^\circ$. Longitudinal control position $\pm 5\%$. Lateral control position $\pm 5\%$. Directional control position $\pm 5\%$. Collective control position $\pm 5\%$.	In ground effect (IGE). Out of ground effect (OGE). Stability augmentation ON and OFF.	Four test conditions required: • 10%, 30% and 70% of rotor diameter height for IGE; and • more than 150% of rotor diameter height for OGE		X	Light and heavy gross masses. Tests may be snapshot tests.
		Torque $\pm 3\%$. Collective control position $\pm 5\%$.		Separate tests required for IGE and OGE.	X		Tests may be snapshot tests.

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
1.4	Vertical climb performance	Vertical velocity ± 0.50 m/s (100 ft/min) or $\pm 10\%$. Directional control position $\pm 5\%$. Collective control position $\pm 5\%$.	OGE.	Light and heavy gross masses. Stability augmentation ON and OFF	X	X	Tests may be snapshot tests.
1.5	Level flight performance and trimmed flight control position	Torque $\pm 3\%$. Pitch angle $\pm 1.5^\circ$. Sideslip angle $\pm 2^\circ$. Longitudinal control position $\pm 5\%$. Lateral control position $\pm 5\%$. Directional control position $\pm 5\%$. Collective control position $\pm 5\%$.	Cruise (Augmentation On and Off).	Two combinations of gross mass/CG and for each combination several speeds from Vy up to VH within the flight envelope.	X	X	Tests may be snapshot tests.

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
1.6	Climb performance and trimmed flight control position	Vertical velocity ± 0.50 m/s (100 ft/min) or $\pm 10\%$. Pitch angle $\pm 1.5^\circ$. Sideslip angle $\pm 2^\circ$. Longitudinal control position $\pm 5\%$. Lateral control position $\pm 5\%$. Directional control position $\pm 5\%$. Collective control position $\pm 5\%$. Airspeed ± 3 kts.	All engines operating. One engine inoperative. Stability augmentation ON or OFF	Two gross mass/CG combinations. Data presented at relevant climb power conditions.	X	X	Tests may be snapshot tests. Tolerance on speed is only applicable to time history tests. For Level 2: The achieved measured vertical velocity of the FSTD cannot be less than the appropriate approved RFM values. Sideslip angle is matched for repeatability only and on continuing recurrent evaluations only.
1.7	Descent						
1.7.1	Descent performance and trimmed flight control position	Torque $\pm 3\%$. Pitch angle $\pm 1.5^\circ$. Sideslip angle $\pm 2^\circ$. Longitudinal control position $\pm 5\%$. Lateral control position $\pm 5\%$. Directional control position $\pm 5\%$. Collective control position $\pm 5\%$. Airspeed ± 3 kts.	Powered descent. Stability augmentation ON or OFF.	Two gross mass/CG combinations. Test to demonstrate a significant rate of descent using a normal approach speed.	X	X	Tests may be snapshot tests. Tolerance on speed is only applicable to time history tests. Sideslip angle is matched for repeatability only and on continuing recurrent evaluations only.

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
1.7.2	Autorotation performance and trimmed flight control position.	Vertical velocity ± 0.50 m/s (100 ft/min) or $\pm 10\%$. Rotor speed $\pm 1.5\%$. Pitch angle $\pm 1.5^\circ$. Sideslip angle $\pm 2^\circ$. Longitudinal control position $\pm 5\%$. Lateral control position $\pm 5\%$. Directional control position $\pm 5\%$. Collective control position $\pm 5\%$.	Steady descents. Stability augmentation ON or OFF	Two gross mass/CG combinations. Speed sweep from approximately the minimum rate of descent airspeed to at least either maximum glide distance airspeed or maximum allowable power-off airspeed, whichever is slower.	X	X	Rotor speed tolerance applies only if collective control position is fully down. Tests may be a series of snapshot tests. Sideslip angle is matched for repeatability only and on continuing recurrent evaluations only.
1.7.3	Autorotational entry	Torque $\pm 3\%$. Rotor speed $\pm 3\%$. Pitch angle $\pm 2^\circ$. Roll attitude $\pm 3^\circ$. Heading $\pm 5^\circ$. Airspeed ± 5 kts. Altitude ± 6.1 m (20 ft).	Cruise and climb.		X	X	Time history of helicopter response following a rapid power reduction to idle up to a stabilized autorotation rate of descent and NR. For cruise, data should be presented for a high speed condition. For climb, data should be presented for the maximum rate of climb airspeed at or near maximum continuous power.
1.8	Landing <i>NOTE; When the speed range for tests 1.8.1, 1.8., and 1.8.3 is less than 40 knots, the applicable airspeed tolerance may be applied to either airspeed or ground speed, as appropriate. If height is not available altitude may be used.</i>						

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
1.8.1	All Engines.	Airspeed $\pm$ 3 kts. Height $\pm$ 6.1 m (20 ft). Torque $\pm$ 3%. Rotor speed $\pm$ 1.5%. Pitch angle $\pm$ 2.5°. Roll angle $\pm$ 2°. Heading $\pm$ 2°.	Approach to hover.	Time history of approach and landing profile down to IGE hover as appropriate to the group of helicopters being simulated.	X	X	
1.8.2	One Engine Inoperative	Airspeed $\pm$ 3 kts. Height $\pm$ 6.1 m (20 ft). Torque $\pm$ 3%. Rotor speed $\pm$ 1.5%. Pitch angle $\pm$ 2.5°. Roll angle $\pm$ 2°. Heading $\pm$ 2°.	Approach and landing.	Include data for both CAT A and CAT B approaches and landings as appropriate to the group of helicopters being simulated.	X	X	Test ends when the first element of the undercarriage touches the ground.

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
1.8.3	Balked landing/missed approach.	Airspeed $\pm$ 3 kts. Height $\pm$ 6.1 m (20 ft). Torque $\pm$ 3%. Rotor speed $\pm$ 1.5%. Pitch angle $\pm$ 2.5°. Roll angle $\pm$ 2°. Heading $\pm$ 2°.	Approach, one engine inoperative.	Test to demonstrate a missed approach manoeuvre that is performed from an OEI stabilized approach or includes a dynamic engine failure during the approach.	X	X	
1.9	Level flight acceleration	Airspeed $\pm$ 3 kts. Torque $\pm$ 3%. Pitch angle $\pm$ 2°. Roll angle $\pm$ 2°. Heading $\pm$ 2°.	Cruise. Stability augmentation ON or OFF.	Record a coordinated level flight acceleration with a minimum approximate speed range increase from Vy to maximum range airspeed, initiated with a single power increase at the beginning of the manoeuvre (not a continuous increase).	X	X	

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
2. Handling Qualities							
NOTE 1: Pitch, roll, yaw and collective controller position versus force or time should be measured at the control using external test fixtures. An alternative method using recording and measuring instrumentation built into the FSTD is acceptable provided that the sponsor verifies the force and position data from this instrumentation matches the helicopter data by using external measuring equipment while conducting the static control checks, or equivalent means. The verification test must be conducted on-site prior to the initial evaluation and the results of the comparison must be included in the MQTG. If the results are satisfactory, the instrumentation may be used during initial and recurrent evaluations for all required objective control tests. 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.							
NOTE 2: FSTD static control testing (tests 2.1 and 2.2) from the second set of pilot controls is required only 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. Dynamics testing is not required at both pilot positions.							
NOTE 3: For the control sweep tests (tests 2.a.1, 2.a.2 and 2.a.3), in order to enable validation of steep force gradients near control stops, an additional tolerance of $\pm 1.5\%$ of total travel on the position axis should be applied.							
Contact the NSEP for clarification of any issue regarding helicopters with reversible controls or where the required validation data are not attainable.							

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
2.1	Cyclic.	Breakout ± 0.111 daN (0.25 lbf) or $\pm 25\%$. Force ± 0.222 daN (0.5 lbf) or $\pm 10\%$.	Ground	Record results for an uninterrupted control sweep to the stops.	X	X	Conduct test under static conditions with the hydraulic system (if applicable) pressurized; supplemental hydraulic pressurization system may be used. The words “if applicable” regarding stability augmentation systems mean: if an augmentation system is available and if this system may be operational on the ground under static conditions as described here.
			Trim On and Off. Friction Off Augmentation (if applicable) On and Off.	This test does not apply if aircraft hardware modular controllers are used. Flight test data for this test do not require the rotor to be engaged/turning.			
2.2	Collective/ Pedals.	Breakout ± 0.222 daN (0.5 lbf) or $\pm 25\%$. Force ± 0.445 daN (1.0 lbf) or $\pm 10\%$.		Record results for an uninterrupted control sweep to the stops.			
2.2	Brake Pedal Force vs. Position.	± 5 lbs. (2.224 daN) or 10%.	Ground; Static conditions.		X	X	FSTD computer output results may be used to show compliance. When the aircraft braking system is an independent system, the tolerances should be applied only on the breakout and maximum deflection.

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
2.3	Trim System Rate (all applicable systems)	Rate - $\pm 10\%$.	Ground Static conditions. Trim On, Friction Off.	The tolerance applies to the recorded value of the trim rate.	X	X	
2.4	Low airspeed handling qualities						
2.4.1	Trimmed Flight Control Positions.	Torque - $\pm 3\%$ Pitch Attitude - $\pm 1.5^\circ$, Bank Attitude - $\pm 2^\circ$, Longitudinal Control Position: $\pm 5\%$ Lateral Control Position: $\pm 5\%$, Directional Control Position: $\pm 5\%$, Collective Control Position: $\pm 5\%$.	Translational Flight IGE Sideward, rearward, and forward flight. Augmentation On and Off.	Record results for several airspeed increments to the translational airspeed limits and for 45 kts forward airspeed.	X	X	Test may be a series of snapshot tests.

TABLE F2A - ROTORCRAFT - NON-TYPE SPECIFIC FTD - OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
2.4.1	Critical Azimuth	Torque - $\pm 3\%$ Pitch Attitude - $\pm 1.5^\circ$, Bank Attitude - $\pm 2^\circ$, Longitudinal Control Position: $\pm 5\%$ Lateral Control Position: $\pm 5\%$, Directional Control Position: $\pm 5\%$, Collective Control Position: $\pm 5\%$.	Stationary Hover. Augmentation On and Off.	Record results for three relative wind directions (including the most critical case) in the critical quadrant.	X	X	Test may be a series of snapshot tests. An SOC is required to define how to present the results showing the area where the minimum control margin applies based on the helicopter design and RFM or flight test data. Precise wind measurement is very difficult therefore it is preferable to simulate wind by using equivalent translational flight in calm weather condition (no wind). This should allow more precise control of wind conditions by using groundspeed measurement (usually GPS). Ideally, in order to ensure consistency between critical azimuth and other directions (forward, sideward and rearward), it would be practical to collect validation data for this test with tests 2.4.1.
2.5	Longitudinal handling qualities						

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
2.5.1	Control response.	Pitch rate $\pm 10\%$ or $\pm 2^\circ/\text{s}$. Pitch attitude change $\pm 10\%$ or $\pm 1.5^\circ$.	Cruise. Stability augmentation ON and OFF.	Results should be recorded for two cruise airspeeds to include minimum power required speed. Record results for a step control input on the test axis. The off-axes response must show correct trend.	X	X	Attitude change is defined as the attitude change from the value just before the step input. The tolerance is applied continuously from the step input time.
2.5.2	Static stability.	Longitudinal control position change from: - Trim: $\pm 10\%$ or $\pm 6.3 \text{ mm}$ (0.25 in.); or - Trim: $\pm 0.222 \text{ daN}$ (0.5 lbf) or $\pm 10\%$.	Cruise or climb. Autorotation. Stability augmentation ON or OFF.	Record results for a minimum of two speeds on each side of the trim speed taken as reference.	X	X	Test may be a series of snapshot tests. Stability augmentation ON and OFF conditions are only required if the augmentation system includes airspeed regulation.

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
2.5.3a)	Dynamic stability: Long-term response.	± 10% of calculated period. ± 10% of time to ½ or double amplitude, or ± 0.02 of damping ratio. For non-periodic responses, the time history must be matched over a 20s period following release of the controls within ± 20% or ± 3° of pitch attitude change; and ± 5 kts of airspeed.	Cruise. Stability augmentation OFF.	For periodic responses, record results for three full cycles (six overshoots after input is completed) or that sufficient to determine time to one-half or double amplitude, whichever is less.	X	X	The test may be terminated prior to 20s if the test pilot determines that the results are becoming uncontrollably divergent. The response may be unrepeatable throughout the stated time for certain helicopters. In these cases, the test should show at least that a divergence is identifiable. For example: displacing the cyclic for a given time or until a given pitch attitude is achieved normally excites this test and then returning the cyclic to the original position. For non-periodic responses, results should show the same convergent or divergent character as the flight test data.

TABLE F2A - ROTORCRAFT - NON-TYPE SPECIFIC FTD - OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
2.5.3b)	Dynamic stability: Short-term response.	$\pm 1.5^\circ$ pitch angle or $\pm 2^\circ/\text{s}$ pitch rate. $\pm 0.1 \text{ g}$ normal acceleration.	Cruise or climb. Stability augmentation ON and OFF.	Record results for at least two airspeeds. A control doublet inserted at the natural frequency of the aircraft normally excites this test. However, while input doublets are preferred over pulse inputs for augmentation-OFF tests, for augmentation- ON tests, when the short-term response exhibits first-order or deadbeat characteristics, longitudinal pulse inputs may produce a more coherent response.	X	X	Note 1. — A Doublet (Longitudinal) input may be generated by pulling back the pitch control sharply and holding input for 5 seconds, pushing forward the pitch control sharply and holding input for 5 seconds, and then releasing the pitch control to neutral position. Inputs should be large enough to produce $\pm 0.2\text{g}$ load factor and/or ± 5 to 15 degree pitch attitude excursions. Note 2. — Deadbeat response to step commands is demonstrated by a system that rapidly reaches a stable state and holds that state with minimal overshoot.
2.5.4	Manoeuvring stability.	Longitudinal control position change from: - Trim: $\pm 10\%$ or $\pm 6.3 \text{ mm}$ (0.25 in.); or - Trim: $\pm 0.222 \text{ daN}$ (0.5 lbf) or $\pm 10\%$.	Cruise or climb. Stability augmentation ON or OFF. Left and right turns.	Results should be recorded for two airspeeds to include minimum power required speed. For each airspeed condition the results should include roll angles at approximately 30° and 45° .	X	X	The force may be shown as a cross plot for irreversible systems. This may be a series of snapshot tests.
2.6	Lateral and directional handling qualities						

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
2.6.1	a) Lateral control response.	Roll rate $\pm 10\%$ or $\pm 3^\circ/\text{s}$. Roll attitude change $\pm 10\%$ or $\pm 3^\circ$.	Cruise. Stability augmentation	Record results for at least two airspeeds, including the speed at or near the minimum power required airspeed. Record results for a step control input on the test axis. The off axes response must show correct trend.	X	X	Attitude or heading change are defined as the attitude/heading change from the value just before the step input. The tolerance is applied continuously from the step input time.
	b) Directional control response.	Yaw rate $\pm 10\%$ or $\pm 2^\circ/\text{s}$. Heading change $\pm 10\%$ or $\pm 2^\circ$.	ON and OFF.				

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
2.6.2	Directional static stability	Roll attitude $\pm 1.5^\circ$. Vertical velocity $\pm 10\%$ or ± 0.50 m/s (100 ft/min). Lateral control position change from: Trim: $\pm 10\%$ or ± 6.3 mm (0.25 in.); or - Trim: $\pm 10\%$ or ± 0.222 daN (0.5 lbf). Directional control position change from: - Trim: $\pm 10\%$ or ± 6.3 mm (0.25 in.); or - Trim: $\pm 10\%$ or ± 0.444 daN (1 lbf). Longitudinal control position change from: - Trim: $\pm 10\%$ or ± 6.3 mm (0.25 in.); or - Trim: $\pm 10\%$ or ± 0.222 daN (0.5 lbf).	Climb or descent. Stability augmentation ON or OFF.	Record results for at least two sideslip angles on either side of the trim point.			This may be a series of snapshot tests. This is a steady heading sideslip test at a fixed collective position. The force may be shown as a cross plot for irreversible systems.
2.6.3	Dynamic lateral and directional stability:						

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
	a) Lateral-directional oscillations.	± 0.5 s or $\pm 10\%$ of period. $\pm 10\%$ of time to 1/2 or double amplitude or ± 0.02 of damping ratio. $\pm 20\%$ or ± 1 s of time difference between peaks of bank and sideslip. For non-periodic responses, the time history must be matched over a 20 s period following release of the controls within: $\pm 5^\circ/\text{s}$ of roll rate or $\pm 5^\circ$ of roll attitude change; and $\pm 4^\circ/\text{s}$ of yaw rate or $\pm 4^\circ$ of heading.	Cruise or climb. Stability augmentation ON and OFF.	The test must be initiated with a cyclic or a pedal doublet input. Record results for: - at least two airspeeds, and - six full cycles (12 overshoots after input is completed) or a number of cycles sufficient to determine time to one-half or double amplitude, whichever is less.			The test may be terminated prior to 20 s if the test pilot determines that the results are becoming uncontrollably divergent.

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
	b) Spiral stability.	Correct trend and $\pm 2^\circ$ or $\pm 10\%$ of roll angle in 20 s. If alternate test is used: Lateral control position change from trim: $\pm 20\%$ or ± 12.7 mm (0.5 in.).		Record the results of turns for 20 s following a release from pedal-only or cyclic-only inputs. Results must be recorded from turns in both directions. Terminate the test at zero roll angle or when the test pilot determines that the attitude is becoming uncontrollably divergent.			As an alternative test: record the results of the lateral cyclic input only (no pedal input) required to maintain a bank angle position of approximately 30 degrees from a steady flight trim. This may be a series of snapshot tests.
3. VISUAL SYSTEM							
3.1	Continuous field of view.	Visual display providing each pilot simultaneously with a minimum of 210° horizontal and 60° vertical continuous field of view. With the image centred on the helicopter centreline the offset from each pilot's eye position should not exceed 10 degrees inboard.	Not Applicable			X	The field of view should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of 5° squares. Installed alignment should be confirmed in an SOC (this would generally be results from acceptance testing).

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
3.2	Display field of view.	Visual field of view for each pilot of a minimum of 45° horizontally and 30° vertically, unless restricted by the type of helicopter, simultaneously for each pilot. With the image centred on the helicopter centreline the offset from each pilot's eye position should not exceed 10 degrees inboard.	Not Applicable		X		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. A 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.
	System geometry — Image position.	From each eyepoint position, the centre of the image is between 0° and 10° inboard in the horizontal plane with the image centred on the helicopter centreline and within ± 0.25° vertically and ± 0.5° horizontally.	Not Applicable			X	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.
	System geometry — Absolute geometry.	Within the specified minimum FOV all points on a 5° grid should fall within 3° of the design position as measured from each pilot eyepoint, when the image is aligned with the relevant eyepoint. The geometry of the image should have no distracting discontinuities.	Not Applicable			X	Where a system with more than the minimum FOV is supplied, the geometry outside the central area should not have any distracting discontinuities.
					X		

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
	System geometry — Relative geometry.	The relative position from one point to the next should not exceed: Zone 1: 0.075°/degree; Zone 2: 0.15°/degree; and Zone 3: 0.2°/degree.	Not Applicable	Measurements of relative dot positions should be made every 5 degrees. In the area from -10° to the lowest visible point, at 15° azimuth inboard, 0°, 30°, 60° and 85° degrees azimuth outboard for each pilot position, vertical measurements should be made every 1° to the edge of the visible image.		X	Zone 1 covers + 5 degrees to – 15 degrees vertically by ± 80 degrees horizontally; Zone 2 covers + 10 degrees to - 25 degrees vertically by ± 90 degrees horizontally excluding the area covered by Zone 1; and Zone 3 covers + 20 degrees to – 40 degrees vertically by ± 105 degrees horizontally excluding the area covered by Zones 1 and 2. <i>Note: A means to perform this check with a simple go/no go gauge is encouraged for recurrent testing.</i>
	Surface resolution (Object detection).	Not greater than 2 arc minutes. Not greater than 4 arc minutes.	Not Applicable	The object will subtend 2 arc minutes to the eye. The object will subtend 4 arc minutes to the eye.		X X	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. 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.

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
	Light-point size.	Not greater than 5 arc minutes.	Not Applicable	Light-point size should be measured using a test pattern consisting of a single row of 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.		X	An SOC is required to state test method and calculation.
		Not greater than 8 arc minutes.			X		
	Raster surface contrast ratio.	Not less than 5:1.	Not Applicable	Surface contrast ratio should be measured using a raster drawn test pattern filling the entire visual scene (all channels). The test pattern should consist of black and white squares, 5° per square		X	Note 1: During contrast ratio testing, FSTD aft cabin and cockpit ambient light levels should be as low as possible.

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
		Not less than 4:1.		with a white square in the centre of each channel. Measurement should be made on the centre bright square for each channel using a 1° spot photometer. This value should have a minimum brightness of 7 cd/m² (2 ft lamberts). Measure any adjacent dark squares. The contrast ratio is the bright square value divided by the dark square value.	X		Note 2: Measurements should be taken at the centre of squares to avoid light spill into the measurement device.
	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.		X	Note: Light-point modulation should be just discernible on calligraphic systems but will not be discernable on raster systems.
		Not less than 8:1.			X		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 cabin and cockpit ambient light

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
	Light-point brightness.	Not less than 30 cd/m2 (8.8 ft-lamberts).	Not Applicable	Light-points should be: • Displayed as a matrix creating a square. • Overlapped such that the square is continuous (individual light-points will not be visible).		X	
	Surface brightness.	Not less than 20 cd/m2 (5.8 ft-lamberts) on the display.	Not Applicable	Surface brightness should be measured on a white raster and measuring the brightness using the 1° spot photometer.		X	Light-points are not acceptable

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
	Black level and sequential contrast.	Black intensity: - Black polygon brightness —ambient brightness < 0.015 cd/m² (0.004 ft-lamberts). Sequential contrast: - White polygon brightness / (black polygon brightness — ambient brightness) > 2 000:1.	Not Applicable	Mount the light meter in a fixed position viewing the forward centre area of each display. Turn all projectors off and make the cockpit environment as dark as possible. Take a reading of the remaining ambient light on the screen. Turn the projectors back on and display a black polygon. Take a second reading and compute the difference between this and the ambient level recorded. A full brightness white polygon should then be measured for the sequential contrast test.		X	This test is generally only required for light valve projectors. An SOC should be provided if the test is not run, stating why.

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
	Motion blur.	Modulation between white squares should be visible on gaps of 3 arc min or less when the pattern is rotated at 10°/s.	Not Applicable	A test pattern consisting of an array of five peak white squares with black gaps between them of decreasing width. Rotate the pattern 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 size of the gaps.		X	Note: This test can be limited by the display technology. Where this is the case consult the NSEP regarding the limitations. This test is generally only required for light valve projectors. The range of black gap widths should at least extend above and below the required detectable gap, and be in steps of 1 arc min. The peak white squares should be four times wider than the black gap width to avoid temporal aliasing. An SOC should be provided if the test is not run, stating why.

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS

Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
	Visual ground segment.	Near end: the correct number of approach lights within the computed VGS should be visible. Far end: $\pm 20\%$ of the computed VGS. Where the threshold lights are computed to be visible they should be visible in the FSTD.	Trimmed in the landing configuration at 30 m (100 ft) wheel/skid 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: 1) RVR/Visibility; 2) glide slope (G/S) and localizer modelling accuracy (location and slope) for an ILS; 3) for a given mass, configuration and speed representative of a point within the helicopter's operational envelope for a normal approach and landing; and 4) Radio altimeter.		X	This test applies only to helicopters equipped with ILS. Where the straight-ahead down view of the helicopter exceeds the display system downward FOV, the display down view angle should be used for the test. For non-type-specific devices, a cut-off angle typical of the group of helicopters should be used. <i>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.</i>
	Visual System content: Day, dusk and night.	Not less than: 10 000 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.		X	

TABLE F2A – ROTORCRAFT – NON-TYPE SPECIFIC FTD – OBJECTIVE TESTS							
Entry #	Test	Tolerance	Flight Condition	Test Details	FTD Level		Comments
					1	2	
		Not less than: 6 000 visible textured surfaces, 1 000 light-points,					
				The required surfaces, light-points and moving models should be displayed simultaneously. The stated capacity should be available in all time of day conditions.	X		

Appendix F3 – Rotorcraft - Non-Type Specific FTD – Functions and Subjective Evaluation

Table F3A - Rotorcraft - Non-Type Specific FTD – Functions and Subjective Evaluation

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION				
Item #	Requirement	Level		Comment
		1	2	
1. Preparation for flight.				
Functional check. Accomplish a functions check of all switches, indicators, systems, and equipment at all crew members’ and instructors’ stations and determine that:				
1.1	The cockpit design and functions are representative of the group of helicopter.	X	X	
1.2	The ambient lighting provides an even level of illumination and is not distracting to the flight crew members.	X	X	
2. Surface operations (pre-take-off).				
2.1	APU/Engine start and run-up. a) Normal start b) Alternate start procedures c) Abnormal starts and shutdowns (hot start, hung start, fire, etc.). d) Rotor start/engagement and acceleration. e) Rotor disengagement and deceleration (needles split). f) After start systems checks (e.g. electrical, hydraulic, flight controls, autopilot, radios, and lighting systems).	X	X	
2.2	Taxi — Ground. a) Collective lever/cyclic friction setting. b) Brakes operation (effectiveness/failure). c) Ground handling. d) Minimum radius turn. e) Surface contaminants (water, snow, ice, sand, etc.).	X	X	
2.3	Taxi — Hover/air/transit/translational flight. a) Lift-off characteristics with and without wind. b) Hover characteristics, engine and flight instruments response. • In ground effect (IGE). • Out of ground effect (OGE). • With and without wind. c) Hover power check. • In ground effect (IGE). • Out of ground effect (OGE). d) Hover turns (around a spot, about the nose/tail). e) Anti-torque/directional control effect. f) Translating tendency. g) No wind/headwind/crosswind/tailwind hover. h) Air taxi/transit/translational flight (forward, sideward, rearward).		X	Note: Hovering modes should include SAS ON and OFF, height stability ON and OFF, cyclic trim ON and OFF.
3. Take-off and departure.				
3.1	Normal. • From ground. • From hover. (CAT B or PC3)		X	
3.2	Crosswind/tailwind.		X	

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
3.3	Maximum performance.		X	
3.4	MCTM.		X	
3.5	Instrument.	X	X	
3.6	Confined area.		X	
3.7	Slope.		X	
3.8	Obstacle clearance.		X	
3.9	Elevated heliport/helideck/pinnacle/platform.		X	
3.10	Vertical.		X	
3.11	High altitude.		X	
3.12	Take-off in snow, sand, dust.		X	
3.13	Transition into forward flight.		X	
3.14	Abnormal/emergency procedure during take-off and departure a) Rejected take-off/forced landing. • Over land. • Over water. b) CAT A and/or PC1/PC2. - Engine failure at or after TDP.		X	
3.15	Instrument departure.	X	X	
4. Climb.				
4.1	Normal.	X	X	
4.2	Obstacle clearance.		X	
4.3	Best rate.	X	X	
4.4	Best angle.	X	X	
4.5	Vertical climb.		X	
4.6	One (or more) engine(s) inoperative.		X	
4.7	Level-off.	X	X	
4.8	CAT A and/or PC1/PC2 operation for all certified profiles with engine failure up to 300 m (1 000 ft) above heliport elevation.		X	
5. Cruise.				

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
5.1	Performance characteristics and flying qualities			
	a) Straight and level flight.	X	X	
	b) Low speed flight (not below ETL speed).			
5.2	Turns.			
	a) Normal.	X	X	
	b) Standard rates (rate 1/2, 1 and 2).			
5.3	En-route navigation.			
	a) Terrain accuracy for forced landing area selection.		X	
	b) Terrain accuracy for visual navigation.			
	c) Radio navigation.	X	X	
6. Descent and arrival.				
6.1	Normal descent.	X	X	
6.2	Maximum rate descent/non-emergency autorotation (VFR and IFR).	X	X	
6.3	Instrument arrival.	X	X	
7. Instrument approaches and landing.				
Select only those instrument approach and landing tests relevant to the simulated helicopter type. Tests with limiting wind velocities and with relevant system failures.				
7.1	Precision approach down to decision height/altitude.			
	a) All engines operating.	X	X	
	b) One (or more) engine(s) inoperative.			
	c) Autopilot coupled approach (3, 4 axis).			
	d) Manual approach with FD guidance.			
	e) Manual approach without FD guidance (raw data).			
	f) With HUD/EFVS.		X	
	Precision Approach procedures.			
	g) ILS. - CAT I published approaches.	X	X	
	h) DGPS/GLS.			
7.2	Non-precision approach down to MDA/H.			
	a) All engines operating.	X	X	
	b) One (or more) engine(s) inoperative.			
	c) Autopilot coupled approach (3, 4 axis).			
	d) Manual approach with FD guidance.			
	e) Manual approach without FD guidance (raw data).			
	f) With HUD/EFVS.		X	
	Non-precision approach procedures.			
	g) ARA.		X	

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
	h) NDB. i) VOR, VOR/DME, TACAN. j) RNAV/RNP/GNSS/RNP APCH, RNP AR APCH, PINS. k) ILS LLZ (LOC), LLZ back course (or LOC-BC). l) ILS offset localizer/SDF (Simplified Directional Facility). m) Circling (approach prior to visual circling manoeuvre).	X	X	
7.3	Missed approach (including at MAP). a) All engines operating, manual and autopilot coupled. b) One (or more) engine(s) inoperative, manual and autopilot coupled.	X	X	
8. Visual approaches.				
8.1	Visual approaches. a) Normal. b) Steep. c) Shallow. d) Vertical. e) Elevated landing sites/pinnacle/ridgelines/slope. f) Helideck (ship)/rig. g) Confined area. h) Crosswind/tailwind. i) Visual traffic pattern. j) Visual circling to land manoeuvre after an instrument approach. k) Quick stop. l) Forced landing approach. m) Transition to hover n) With HUD/EFVS.		X	
8.2	Balked landing. a) All engines operating. b) One engine inoperative. c) Balked rig/deck landing.		X	
8.3	CAT A or PC1/PC2 operation for all certified profiles from 300 m (1 000 ft) above heliport elevation to or after LDP.		X	
9. Landing transition/touchdown.				
9.1	From a hover.		X	
9.2	Crosswind/tailwind.		X	
9.3	High altitude.		X	
9.4	Elevated landing sites/pinnacle/ridgelines.		X	
9.5	From a visual approach.		X	
9.6	From an instrument approach to minimums and visual final approach thereafter.	X	X	

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
9.7	CAT A operation for all certified profiles (PC1/PC2). - Landing with engine failure prior to LDP. - Landing with engine failure at or after LDP.		X	
10. Engine shutdown and parking.				
10.1	Engine and systems operation.	X	X	
10.2	Parking brake operation.	X	X	
10.3	Rotor disengagement and deceleration.	X	X	
10.4	Rotor brake operation.	X	X	
10.5	Emergency evacuation.	X	X	
11. Any flight phase. Helicopter and power plant systems operation (where fitted) including associated abnormal and emergency procedures required for approved use.				
11.1	Air conditioning and ventilation system.	X	X	
11.2	Autopilot and flight director.	X	X	
11.3	Stability and control augmentation system.	X	X	
11.4	Communications.	X	X	
11.5	Electrical system.	X	X	
11.6	Fire and smoke detection and suppression system.	X	X	
11.7	Flight controls.	X	X	
11.8	Flight control computers.	X	X	
11.9	Stabilizer/stabilator.	X	X	
11.10	Fuel and oil systems.	X	X	
11.11	Hydraulic system.	X	X	
11.12	De-icing/anti-icing system.	X	X	
11.13	Landing gear including landing gear operating time and floats deployment.	X	X	

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
11.14	Lighting (internal and external).	X	X	
11.15	Oxygen system.	X	X	
11.16	Pneumatic system.	X	X	
11.17	Auxiliary engine/auxiliary power unit (APU).	X	X	
11.18	Engine.	X	X	
11.19	Transmission systems.	X	X	
11.20	Rotor systems.	X	X	
11.21	Flight data display systems.	X	X	
11.22	Flight instruments system.	X	X	
11.23	Flight management systems.	X	X	
11.24	Head-up displays (including EFVS, if appropriate).		X	
11.25	Navigation systems.	X	X	
11.26	Electronic flight bag.		X	
11.27	Automatic checklists (normal, abnormal and emergency procedures).	X	X	
11.28	Voice activated systems.	X	X	
11.29	Airborne and other miscellaneous procedures.	X	X	
	a) Holding.			
	b) Recovery from unusual attitudes.			
	c) Mast bumping.		X	
	d) Inadvertent entry into IMC.			
11.30	Stability augmentation malfunction in flight.	X	X	
11.31	Autopilot malfunction in flight.	X	X	
11.32	Engine fire in forward flight.	X	X	
11.33	Engine malfunctions.	X	X	
11.34	Airframe fire and smoke in forward flight.	X	X	
11.35	Engine failure before CDP/rejected take-off.		X	
11.36	Engine failure after CDP (multi-engine).		x	

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
11.37	OEI instrument approaches and go-around.	X	X	
11.38	Recovery from unusual attitudes.	X	X	
11.39	MGB/IGB/TRGB chip detector/oil pressure warning in the hover.		X	
11.40	MGB/IGB/TRGB chip detector/oil pressure warning in forward flight.	X	X	
11.41	Hydraulic failure in forward flight.	X	X	
11.42	Hydraulic jack stall (servo transparency).	X	X	
11.43	Instrumentation/indication failure VFR.	X	X	
11.44	Instrumentation/indication failure IFR.	X	X	
11.45	DC system failure.	X	X	
11.46	AC system failure.	X	X	X
11.47	Battery failure.	X	X	
11.48	Total electrical failure.	X	X	
11.59	Engine icing.	X	X	
11.60	Anti-icing system malfunctions.	X	X	
12. Visual System.				
The functions and subjective tests described in this section apply to those real-world or fictitious airports and other landing areas intended for use in the operator's approved training programs. However, where the requirements allow, the operator may elect to use demonstration models for use during the initial qualification which need not be fully up-to-date nor replicate any particular airport (fictitious airport). Not all elements described in this section need to be found in a single airport/landing area scene. However, all of the elements described in this section should be found throughout a combination of the required airport/landing area model(s) described below. During recurrent evaluations, the evaluator may select any visual scene used in the operator's training programme(s) to conduct a functions and subjective test, provided these visual scenes were modelled with the features required.				
Functional test content requirements. The following minimum airport/landing area model content is required to satisfy visual capability tests and provide suitable visual cues to conduct 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. Note: The term "landing area" used herein includes both prepared (e.g. airport pad, oil rig, hospital) and unprepared (e.g. confined area, pinnacle, slope) helicopter operations areas.				
12.1	a) A minimum of one (1) representative airport model and one (1) helicopter landing area. These models should be acceptable to the operator's evaluator and selectable from the IOS.		X	Note: Real-world models need to be consistent with published data used for helicopter operations
	b) A minimum of one (1) generic airport/heliport model. This model should be acceptable to the operator's NAA and selectable from the IOS.	X		

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
12.2	Visual scene fidelity.			
	a) The fidelity of the visual scene and visual cues should be sufficient for the flight crew to: - visually identify the airport/landing area; - determine the position of the simulated helicopter; - successfully accomplish take-offs, approaches, and landings; and - Manoeuvre around the airport/landing area on the ground or in a hover/air taxi as necessary.		X	
	b) Visual cues availability should enable the flight crew to assess the rate of change of height and translational displacements and rates, during take-off and landing.			
	c) Visual scenes with sufficient scene content for the flight crew to successfully accomplish take-offs, approaches and landings.	X		
	d) For cross-country flights, sufficient scene ground details to allow visual navigation using appropriate scale map, as dictated by the training programme and at typical altitudes over a sector length equal to 30 minutes at an average cruise speed.		X	
12.3	Landing areas, runways and taxiways.		X	
	a) Representative landing areas, runways and taxiways.			
	b) Generic landing areas, runways and taxiways.	X		
	c) Helicopter landing areas and runway threshold elevations and locations should be modelled to provide correlation with helicopter systems (e.g. HUD, GPS, compass, altimeter).	X	X	
12.4	Helicopter landing area surface, markings and lighting. Landing area surface and markings for each helicopter landing area should include the following, if appropriate:			
	a) TLOF (Touchdown and Liftoff area)		X	
	b) FATO (Final Approach and Take-off area) designation markings, as appropriate (including design size, "D" value, weight limitations, etc., where appropriate).			
	c) Safety areas, OFS (Obstacle Free Sector) and LOS, as appropriate.			
	d) Signs as appropriate for model used.			
	e) Windsock that gives appropriate wind cues.	X	X	
12.5	Lighting of appropriate colours for the helicopter landing area including the following:			
	a) Landing direction.	X	X	
	b) Windsock lighting.			
	c) Visual approach aids.			
	d) Approach lighting of appropriate colour.			
	e) Raised and flush FATO, TLOF perimeter and flood lighting.		X	
12.6	Taxiway and movement area and markings associated with the helicopter landing area:	X	X	
	a) Taxiways/taxi routes.			

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
	b) Aprons.		X	
Airport surface, markings and lighting:				
12.7	Runway surface and markings for each “in-use” runway should include the following, if appropriate: a) Threshold markings. b) Runway numbers. c) Touchdown zone markings. d) Centre line markings. e) Windsock that gives appropriate wind cues.	X	X	
	f) Fixed distance markings. g) Edge markings. h) Signs at intersecting runways and taxiways.		X	
12.8	Lighting of appropriate colours for the runway in use including the following: a) Threshold lights. b) Edge lights. c) End lights. d) Centre line lights. e) Touchdown zone lights. f) Appropriate approach lighting system for that runway. g) Windsock lighting.	X	X	
	h) Lead-off lights. i) Appropriate visual landing aid(s) for that runway.		X	
12.9	Taxiway surface and markings associated with each “in-use” runway: a) Runway holding position markings.	X	X	
	b) Edge markings. c) Centre line markings. d) ILS critical area markings. 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 those operations authorized in low visibilities. The designated runway and taxi routing should be consistent with that airport for operations in low visibilities.		X	
12.10	Taxiway lighting of appropriate colours, directionality, behaviour and spacing, associated with each “in-use” runway: a) Edge lights. b) Centre line lights. c) Runway holding position and ILS critical area lights	X	X	

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
12.11	Required visual model correlation with other aspects of the airport and landing area environment simulation.			
	a) The airport or helicopter landing area model must align properly with navigational aids associated with operations at the runway “in-use” or helicopter landing area.	X	X	
	b) The simulation of runway or helicopter landing area contaminants should be correlated with the displayed runway surface and lighting.		X	
12.12	Airport and helicopter landing area buildings, structures, objects and lighting.			
	a) Representative airport or helicopter landing area buildings, structures, objects and lighting.		X	
	b) Representative moving and static clutter (e.g. other helicopters and aeroplanes, power carts, tugs, fuel trucks).			
	c) Generic airport or helicopter landing area buildings, structures, objects and lighting.	X		
12.13	Terrain and obstacles.			
	a) Representative depiction of terrain and obstacles within 18.5 km (10 NM) of the reference airport or landing area with colours and textures, as appropriate.		X	
	b) Buildings, trees or other vertical obstructions in the immediate vicinity of the landing area.			
	c) Suspended wires in the immediate vicinity of the landing area.			
	d) Depiction of terrain topographical features within 9.25 km (5 NM) of the reference airport or landing area. A limited area flat world is acceptable.	X		
12.14	Significant, identifiable natural and cultural features and moving airborne traffic.			
	a) Representative depiction of significant and identifiable natural and cultural features within 18.5 km (10 NM) of the reference airport or helicopter landing area. 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 to provide a reasonable facsimile of runway orientation.			
	b) Representative moving airborne traffic (including the capability to present air hazards – e.g. airborne traffic on a possible collision course).			
Visual scene management.				
12.15	All landing area and airport runway, approach and taxiway lighting, and cultural feature lighting intensity for any approach should be capable of being set to six (6) different intensities (0 to 5); all visual scene light-points should fade into view appropriately in accordance with the environmental conditions set in the FSTD.		X	
12.16	Airport runway, approach and taxiway lighting, helicopter landing area approach 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.	X		

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
12.17	The directionality of strobe lights, approach lights, runway edge lights, visual landing aids, runway centre line lights, threshold lights, touchdown zone lights on the runway of intended landing and TLOF or FATO lights should be realistically replicated.	X	X	
Visual feature recognition. <i>Note: The following are the minimum distances at which landing areas and runway features should be visible. Distances are measured from the runway threshold or helicopter landing area to a helicopter aligned with the runway or helicopter landing area on an extended 3-degree glide slope in suitable simulated meteorological conditions. For circling approaches, all tests below apply both to the runway used for the initial approach and to the runway of intended landing.</i>				
12.18	For helicopter landing areas: a) Heliport definition, strobe lights, approach lights, from 4.8 km (3 sm). b) Visual approach aids lights (e.g. HAPI) through approach angles up to 12 degrees. c) Taxiway definition from 3.2 km (2 sm). d) Markings within range of landing lights for night or dusk and dawn scenes. e) Flush mounted FATO lights, TLOF lights, and the lighted windsock from 800 m (0.5 sm). f) Landing direction lights and raised FATO lights from 1.6 km (1 sm). g) Hover taxiway lighting (yellow/blue/yellow cylinders) from TLOF.	X	X	
	h) Markings as required by the surface resolution test on day scenes.		X	
12.19	For runways: a) Runway definition, strobe lights, approach lights, and runway edge white lights from 8 km (5 sm) of the runway threshold. b) Visual approach aids lights (VASIS, PAPI, etc.) from 4.8 km (3 sm) of the runway threshold. c) Runway centre line lights and taxiway definition from 4.8 km (3 sm). d) Threshold lights and touchdown zone lights from 3.2 km (2 sm). e) Runway markings within range of landing lights for night or dusk and dawn scenes.	X	X	
	f) Runway markings as required by the surface resolution test on day scenes. g) For circling approaches, the runway of intended landing and associated lighting should fade into view in a non-distracting manner.		X	
12.20	Selectable airport visual scene capability for: a) Night. b) Dusk or dawn. c) Day.	X	X	
	d) Dynamic effects — the capability to present multiple ground and air hazards, such as an aeroplane or another helicopter crossing the active runway or converging airborne traffic, a supply ship in the vicinity of the oil rig when the helicopter is on final approach for landing, etc.; hazards should be selectable via controls at the instructor station.		X	
12.21	Correlation with helicopter and associated equipment. a) Visual system compatibility with aerodynamic programming. b) Visual cues to relate to actual helicopter responses. c) Accurate portrayal of environment relating to helicopter attitudes.	X	X	
	d) Visual cues to enable assessing sink rate and depth perception during landings.		X	

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
12.22	The visual scene should correlate with integrated helicopter systems, where fitted (e.g. terrain, traffic and weather avoidance systems and HUD/EFVS).			
	a) Weather radar returns should correlate with the visual scene.	X	X	
	b) The visual effects for each visible, own-ship, helicopter external light(s) should be provided – taxi, landing and search light lobes including independent operation.			
	c) The visual system should provide appropriate height and 3-D object collision detection feedback, based on helicopter geometry, to support training.			
	d) Radar equipment used for offshore operations (ARA) should provide appropriate returns simulation correlated with the visual scene.	X		
	e) Terrain awareness warning system (e.g. HTAWS, EGPWS, GPWS) should correlate with the visual scene.			
	f) Airborne collision avoidance systems (e.g. TCAS) should correlate with the visual scene.			
g) The effect of rain removal devices should be provided (i.e. the reduction of rain defocus once activated).				
h) Dynamic visual representation of rotor blades and tip path including effects of rotor start-up and shutdown as well as orientation of the rotor disc due to pilot control input.				
i) Visual representation of rotor blade tip path plane and orientation due to pilot control input.	X			
12.23	Scene quality.			
	a) Surfaces and textural cues should not create distracting quantization (aliasing).	X	X	
	b) The system light-points should be free from distracting jitter, smearing or streaking. Demonstration of occulting through each channel of the system in an operational scene.			
	c) System capable of portraying full colour realistic textural cues.	X		
	d) System capable of providing focus effects that simulate rain.			
e) System capable of providing light-point perspective growth.				
12.24	Environmental effects.			
	a) The displayed scene should correspond to the appropriate surface contaminants and include runway lighting reflections for wet, partially obscured lights for snow, or suitable alternative effects.	X		
	b) Special weather representations, which include the sound, motion and visual effects of light, medium and heavy precipitation near a thunderstorm on take-off, approach and landings at and below an altitude of 600 m (2 000 ft) above the airport or landing area surface and within a radius of 16 km (10 sm) from the aerodrome.			
	c) One airport or landing area with a snow scene, if appropriate to the operator’s area of operations, to include terrain snow and snow-covered surfaces.			
	d) In-cloud effects such as variable cloud density, speed cues and ambient changes should be provided.			
	e) The effect of multiple cloud layers representing few, scattered, broken and overcast conditions giving partial or complete obstruction of the ground scene.			
	f) Gradual breakout to ambient visibility/RVR, defined as up to 10% of the respective cloud base or top, 6.1 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 aerodrome or helicopter landing area and within a radius of 16 km (10 sm) from the aerodrome or helicopter landing area. Transition effects should be complete when the IOS cloud base or top is reached when			

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
	exiting and start when entering the cloud, i.e. transition effects should occur within the IOS defined cloud layer. g) Effects of fog on aerodrome or helicopter landing area lighting such as halos and defocus. h) Effect of own-ship lighting in reduced visibility, such as reflected glare, to include landing lights, search lights, strobes, and beacons. i) The effect of own-ship downwash upon the surface (e.g. grass, dirt, water). j) “Whiteout” or “brownout” recirculation effects of own helicopter’s rotor downwash upon various surfaces such as snow, sand, dirt, water and grass including the effects of reduced visibility beginning at a distance above the ground equal to approximately one half the rotor diameter. k) The effects of swell and wind on a 3-dimensional ocean model should be simulated including wind lanes; sea states of 0 to 6 should be provided. Ships and other moving vessels in the ocean should conform to the sea state. l) Precipitation effects for rain, hail and snow.			
	m) The effect of a cloud layer with adjustable base and top giving complete obstruction of the ground scene.	X		
	n) Visibility and RVR measured in terms of distance. Visibility/RVR should be checked at and below a height of 600 m (2 000 ft) above the aerodrome or helicopter landing area and within a radius of 16 km (10 sm) from the aerodrome or helicopter landing area.	X	X	
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 vibrations characteristics, should be representative of the helicopter.				
13.1	Friction drag from skid-type landing gear. Procedure: perform a running take-off or a running landing and note a change (increase or decrease) with speed in fuselage vibrations (as opposed to rotor vibrations) due to the friction of dragging the skid along the surface. This vibration will lessen as the ground speed decreases.	X	X	
13.2	Translational lift effect (including transverse flow effect). Procedure: from a stabilized in-ground-effect (IGE) hover, begin a forward acceleration. When passing through the effective translational lift range, the noticeable effect will be a possible nose pitch-up in some helicopters, an increase in the rate of climb, and a temporary increase in vibration level (in some cases this vibration may be pronounced). This effect is experienced again upon deceleration through the appropriate speed range. During deceleration, the pitch and rate of climb will have the reverse effect, but there will be a similar, temporary increase in vibration level.	X	X	

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
13.3	Rotor out-of-track and/or out-of-balance condition including icing conditions. Procedure: select the malfunction or condition from the IOS. Start the engine(s) normally and check for an abnormal vibration for an out-of-track condition and check for an abnormal vibration for an out-of balance condition. This test does not require becoming airborne. The abnormal vibration for out-of-track and out-of-balance conditions should be recognized in the frequency range of the inverse of the period P of rotation of the main rotor for each condition, i.e. 1/P for vertical vibration caused by an out-of-track condition, and 1/P for lateral vibration caused by an out-of-balance condition.	X	X	
13.4	Tail rotor drive malfunction/vibrations. Procedure: with the engine(s) running and the rotor engaged, select the malfunction and note the immediate increase of medium frequency vibration. The tail rotor operates in the medium frequency range, normally estimated by multiplying the tail rotor gear box ratio by the main rotor RPM. The failure can be recognized by an increase in the vibrations in this frequency range. Vibrations may be transmitted via the pedals as well.	X	X	
13.5	Engine malfunction and engine damage effects. Procedure: the characteristics of an engine malfunction as prescribed in the malfunction definition document for the particular FSTD must describe the special motion effects felt by the pilot. Note the associated engine instruments varying according to the nature of the malfunction and note the replication of the effects of the airframe vibrations. Note: Motion effects apply to Type IV and V devices.	X	X	
14. Sound system. Note: Checks should be performed with the motion and vibration systems ON.				
14.1	Significant helicopter cockpit sounds and those which result from an action by the pilot.	X	X	
14.2	Abnormal operations for which there are associated sound cues including, but not limited to, engine, rotors, transmissions malfunctions, landing gear/tire malfunctions and tail guard/stinger/hockey stick strike.	X	X	
14.3	Sound of a crash when the helicopter is landed in excess of limitations or in unusual attitudes.	X	X	
15. Instructor operating station.				

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
15.1	Repositions. a) Parking spot. b) Take-off position. c) Approach position (at least at three distances of 1.8, 5.5, 9.3 km (1, 3, 5 nm) from the runway threshold or helicopter landing area).	X	X	<i>Note: Repositions should end in-trim at the appropriate speed and configuration for the point.</i>
15.2	Resets. a) System. b) Temperature. c) Fluids and agents. d) Environment.	X	X	
15.3	Weather presets. a) CAVU (ceiling and visibility unlimited). b) CAVOK. (Ceiling and visibility Ok). c) VFR. d) Non-precision approach minimums. e) Precision approach minimums (CAT I, CAT II, EFVS minimums, as appropriate).	X	X	
15.4	Visual effects. a) Time of day (day, dusk or dawn, night). b) Clouds (bases, tops, layers, types, density). c) Visibility in kilometres/statute miles. d) RVR in metres/feet. e) Special effects (precipitation; thunderstorms; blowing snow, blowing sand, etc.). f) Sand/dust/snow/water downwash/recirculation effect ON/OFF. g) Sea state conditions (0-6).	X	X	
15.5	Wind speed and direction. a) Surface. b) Gusts with associated heading and speed variance. c) Turbulence. d) Intermediate levels.	X	X	
15.6	Temperature — surface.	X	X	
15.7	Atmospheric pressure (QNH, QFE).	X	X	
15.8	Airport/heliport. a) To include active runway or landing area selection. b) Airport/heliport lighting controls. c) Airport/heliport preset positions (take-off, approach, oil rig, etc.). d) Landing surface conditions (rough, smooth, icy, wet, etc.). e) Dynamic effects including ground and airborne traffic.	X	X	

Table F3A - ROTORCRAFT - NON-TYPE SPECIFIC FTD – FUNCTIONS AND SUBJECTIVE EVALUATION

Item #	Requirement	Level		Comment
		1	2	
15.9	Helicopter configuration (fuel, weight, CG, etc., in imperial and metric units). a) Gross weight. b) Fuel loading. c) Payload. d) CG (in units appropriate to the helicopter type, e.g. inches, mm). e) Helicopter systems status/control (e.g. rapid navigation system (NAV) alignment (IRS, GPS, AHRS), others). f) Ground crew functions (ground power, etc.).	X	X	
15.10	Plotting and recording (take-off and approach).	X	X	
15.11	Helicopter malfunctions (inserting and removing).	X	X	
15.12	Sound controls (ON, OFF and adjustment; indication of when the sound level is set to a value other than the approved level).	X	X	
15.13	Control loading system (ON, OFF and emergency stop).	X	X	
15.14	Vibration system (ON, OFF and emergency stop).	X	X	
15.15	Simulator master/emergency power switch "OFF".	X	X	
15.16	Communication between the instructor/observer(s) and the flight crew.	X	X	
15.17	Freezes/resets. a) Complete simulation freeze. b) Flight/problem freeze. c) Position freeze. d) Fuel freeze. e) Ground speed control. f) Standard atmosphere reset.	X	X	

Attachments to Chapter 6

Attachment 6.1 - Sample FTD Certificate for Regional Authorities.

 Transport Canada / Transports Canada		
CERTIFICATE FLIGHT TRAINING DEVICE (FTD)	TC ID 4911	CERTIFICAT DISPOSITIF D'ENTRAÎNEMENT DE VOL (DEV)
Sponsor	Commanditaire	
Roadrunner Flight Academy		
Location	Endroit	
Prairie Ville, SK, Canada		
Manufacturer / Model	Constructeur / Modèle	
Simulo Volitus IX		
Aircraft Class/Set	Classe/Ensemble d'aéronef	
Twin-Engine Turboprop		
Serial Number	Numéro de série	
YLE-Ky0T3		
This certificate is issued pursuant to Section 606.03 of the Canadian Aviation Regulations.		Ce certificat est délivré en vertu de la section 606.03 du Règlement de l'aviation canadien.
Transport Canada – Prairie and Northern Region has evaluated the above Flight Simulation Training Device and found it to comply with:		Transports Canada – Région des Prairies et du Nord a évalué le dispositif d'entraînement de vol et a jugé qu'il était conforme à :
Level 2-IPC/MCC		Niveau 2-IPC/CE
qualification standards and criteria, based on:	TP9685 Rev 3	à la norme et aux critères de qualification, selon:
Dated at Winnipeg, Canada	2018-01-31	Daté à Winnipeg Canada
	For the Minister of Transport	Pour le Ministre des Transports
	Valid Until : Valide jusqu'au :	2019-01-31
This qualification is provisional and may be suspended if the Operator does not satisfactorily address the findings documented in the FSTD Evaluation Report upon which this Certificate was based.		Cette qualification est provisoire et peut être suspendue si l'exploitant ne donne pas suite de façon satisfaisante aux constatations formulées dans le rapport d'évaluation FSTD sur lequel repose le présent certificat.
RDIMS/SGDDI#		

Attachment 6.2 - Non-Type-Specific FTD Qualification Profile

NON-TYPE-SPECIFIC FTD QUALIFICATION PROFILE									
FTD INFORMATION					SPONSOR INFORMATION				
Sponsor:		Roadrunner Flight Academy			Organization Address		123 Beep Blvd		
TCID Number:		4911					Prairie Ville		
FTD Location:		Prairie Ville, SK			Management Representative:		Name: Wiley Coyote		
FTD Model:		Simulo Volitus IX					Tele: (312) 555-1234		
Aircraft Class/Set:		Twin-Engine Turboprop					Email: wcoyote@acme.com		
Qualification Level:		Level 2-IPC/MCC			Technical Representative:		Name:		
Qualification Standard:		TP9685 Rev3					Tele: (same as above)		
FTD Manufacturer:		ACME FTD					Email:		
Date of Manufacture:		2018			TC TPAA (Training Program Approving Authority)		Name: Phil Forms		
Serial Number:		YLE-Ky0T3					Tele: (312) 555-1234		
Convertible to:		TCID 4912					Email: Phil.forms@tc.gc.ca		
Number of Seats		3			FUNCTIONAL AIRCRAFT SYSTEMS				
Visual		Image Gen:		ACME See-right					
		FOV:		150 x 40					
		Projectors:		3 x Spotlight VL – Direct projection					
Computer	ACME PC								
Motion	N/A								
Controls	ACME feels-rite								
REFERENCE DATA RECORD									
Aero-model		Document: ACME Aero D7772							
Engine model		Document: ACME Eng D7772							
ADDITIONAL QUALIFICATIONS									
X	IPC		IFR (5 hrs)	X	IFR (10 hrs)	x	MCC		
Other		VFR cross country							
DESIGNATED VISUAL SCENES									
CYBR			CYWG			CYPG			
QUALIFICATION RESTRICTIONS:									
<i>Manoeuvres, procedures, tasks, and functions not approved due to technical or operational limitations.</i>									
1. No RNP APCH authorized. Integrity warning inoperative.									

NON-TYPE-SPECIFIC FTD QUALIFICATION PROFILE		
DESIGNATED ABNORMALS (for MCC)		
Minimum-Electrics Landing	Fuel Leak	
Pressurization Loss		
Manual Gear lowering.		
QTG File Location:	RDIMS #: 139662 (or "held on site")	
RDR File Location:	RDIMS #: 139662	

Chapter 7 - Evaluation Criteria and Requirements for Additional Qualifications

7.1 Overview

- 7.1.1 The qualifications described in this Chapter may be mandatory or optional for some qualification levels (as prescribed in Chapters 4 and 5 Qualification Performance Standards (QPS)), or can be included as an additional qualification for other Flight Simulator Training Devices (FSTD) levels that are modified to meet the requirements herein. This appendices in this chapter describe the FSTD evaluation criteria and requirements, regardless of the level, that the National Simulator Evaluation Program (NSEP) will use to qualify an FSTD for pilot training and checking in the following special manoeuvres:
- Windshear Training Program Use;
 - Full Stall Training Tasks;
 - Upset Prevention and Recovery Training Tasks;
 - Engine and Airframe Icing Training Tasks;
 - Takeoff and Landing in Gusting Crosswinds; and
 - Bounced Landing Recovery Training Tasks.
- 7.1.2 To qualify an FSTD for the additional qualification in this chapter, the sponsor must make their request in the letter of intent for an initial evaluation, or subsequently in accordance with the procedure at section 3.7 of Chapter 3.
- 7.1.3 Additional qualifications not presented in this chapter may also be eligible for evaluation provided that the sponsor confirms with the Training Program Approval Authority (TPAA) prior to the evaluation that the intended training and checking is relevant to the approved training program.
- 7.1.4 In cases where this manual does not address the evaluation criteria and requirements for unique or special qualifications, the sponsor should consult with the Manager Simulator Program (MSP) to determine what evaluation criteria will be used and whether any addition data are required.

7.2 Aeroplane Full Flight Simulator - Qualification Requirements for Windshear Training Program Use

- 7.2.1 **Applicability.** This section applies to all simulators, regardless of qualification level, that are used to satisfy the training requirements of any Transport Canada-approved training program that addresses windshear encounters.
- 7.2.2 Statement of Compliance and Capability.
- The sponsor must submit a Compliance and Capability (SOC) confirming that the aerodynamic model is based on flight test data supplied by the airplane manufacturer or other approved data provider. The SOC must also confirm that any change to environmental wind parameters, including variances in those parameters for windshear conditions, once inserted for computation, result in the correct simulated performance. This statement must also include examples of environmental wind parameters currently evaluated in the simulator (such as crosswind takeoffs, crosswind approaches, and crosswind landings).
 - For simulators without windshear warning, caution, or guidance hardware in the original equipment, the SOC must also state that the simulation of the added hardware and/or software, including associated flight deck displays and annunciations, replicates the system(s) installed in the airplane. The statement must be accompanied by a block diagram depicting

the input and output signal flow, and comparing the signal flow to the equipment installed in the airplane.

7.2.3 **Models.** The windshear models installed in the simulator software used for the qualification evaluation must do the following:

- a. Provide cues necessary for recognizing windshear onset and potential performance degradation requiring a pilot to initiate recovery procedures. The cues must include all of the following, as appropriate for the portion of the flight envelope:
 - 1) Rapid airspeed change of at least ± 15 knots (kts).
 - 2) Stagnation of airspeed during the takeoff roll.
 - 3) Rapid vertical speed change of at least ± 500 feet per minute (fpm).
 - 4) Rapid pitch change of at least $\pm 5^\circ$.
- b. Be adjustable in intensity (or other parameter to achieve an intensity effect) to at least two (2) levels so that upon encountering the windshear the pilot may identify its presence and apply the recommended procedures for escape from such a windshear.
 - 1) If the intensity is lesser, the performance capability of the simulated airplane in the windshear permits the pilot to maintain a satisfactory flightpath; and
 - 2) If the intensity is greater, the performance capability of the simulated airplane in the windshear does not permit the pilot to maintain a satisfactory flightpath (crash).

Note: The means used to accomplish the "non-survivable" scenario of paragraph 3.b.(2) of this section, that involve operational elements of the simulated airplane, must reflect the dispatch limitations of the airplane.

- c. Be available for use in an approved windshear flight training program.

7.2.4 Demonstrations.

- a. The sponsor must identify one survivable takeoff windshear training model and one survivable approach windshear training model. The wind components of the survivable models must be presented in graphical format so that all components of the windshear are shown, including initiation point, variance in magnitude, and time or distance correlations. The simulator must be operated at the same gross weight, airplane configuration, and initial airspeed during the takeoff demonstration (through calm air and through the first selected survivable windshear), and at the same gross weight, airplane configuration, and initial airspeed during the approach demonstration (through calm air and through the second selected survivable windshear).
- b. In each of these four situations, at an "initiation point" (i.e., where windshear onset is or should be recognized), the recommended procedures for windshear recovery are applied and the results are recorded as specified in paragraph 6.2.5 of this section.
- c. These recordings are made without inserting programmed random turbulence. Turbulence that results from the windshear model is to be expected, and no attempt may be made to neutralize turbulence from this source.
- d. The definition of the models and the results of the demonstrations of all four (4) cases described in paragraph 4.a. of this section, must be made a part of the Master Qualification Test Guide (MQTG).

7.2.5 Recording Parameters.

- a. In each of the four MQTG cases, an electronic recording (time history) must be made of the following parameters:
 - 1) Indicated or calibrated airspeed.
 - 2) Indicated vertical speed.

- 3) Pitch attitude.
 - 4) Indicated or radio altitude.
 - 5) Angle of attack.
 - 6) Elevator position.
 - 7) Engine data (thrust, N1, or throttle position).
 - 8) Wind magnitudes (simple windshear model assumed).
 - b. These recordings must be initiated at least 10 seconds prior to the initiation point, and continued until recovery is complete or ground contact is made.
- 7.2.6 **Equipment** Installation and Operation. All windshear warning, caution, or guidance hardware installed in the simulator must operate as it operates in the airplane. For example, if a rapidly changing wind speed and/or direction would have caused a windshear warning in the airplane, the simulator must respond equivalently without instructor/evaluator intervention.
- 7.2.7 Qualification Test Guide.
- a. All Qualification Test Guide (QTG) material must be forwarded to the MSP.
 - b. A simulator windshear evaluation will be scheduled in accordance with normal procedures. Continuing qualification evaluation schedules will be used to the maximum extent possible.
 - c. During the on-site evaluation, the evaluator will ask the operator to run the performance tests and record the results. The results of these on-site tests will be compared to those results previously approved and placed in the QTG or MQTG, as appropriate.
 - d. QTGs for new (or MQTGs for upgraded) simulators must contain or reference the information described in paragraphs 6.2.2, 6.2.3, 6.2.4, and 6.2.5.
- 7.2.8 **Subjective Evaluation.** The NSPM will fly the simulator in at least two of the available windshear scenarios to subjectively evaluate simulator performance as it encounters the programmed windshear conditions.
- a. One scenario will include parameters that enable the pilot to maintain a satisfactory flightpath.
 - b. One scenario will include parameters that will not enable the pilot to maintain a satisfactory flightpath (crash).
 - c. Other scenarios may be examined at the MSP's discretion.
- 7.2.9 Qualification Basis. The addition of windshear programming to a simulator in order to comply with the qualification for required windshear training does not change the original qualification basis of the simulator.
- 7.2.10 Demonstration Repeatability. For the purposes of demonstration repeatability, it is recommended that the simulator be flown by means of the simulator's auto-drive function (for those simulators that have auto-drive capability) during the demonstration

7.3 Aeroplane Full Flight Simulator - Qualification Requirements for Full Stall Training Tasks

- 7.3.1 The evaluation requirements in this section are intended to validate an aeroplane FFS fidelity at angles of attack sufficient to identify the stall, to demonstrate aircraft performance degradation in the stall, and to demonstrate recovery techniques from a fully stalled flight condition.
- 7.3.2 **Applicability.** This Section applies to previously qualified Level C and Level D FSTDs being used to obtain credit for stall training maneuvers beyond the first indication of a stall (such as stall warning system activation, stick shaker, etc.) in an Transport Canada approved training program.

7.3.3 **Evaluation Criteria and Requirements.** Any Full Flight Simulator (FFS) used in pilot training and checking for full stall training maneuvers in an Transport Canada approved training program must be evaluated and issued an additional qualification in accordance with the criteria and requirements in this Section and the following sections of this manual:

- a. Appendix A1, Table A1A, Aeroplane FFS - General Requirements;
 - 1) Section 2.m (High Angle of Attack Modeling), and
 - 2) Section 3.f (Stick Pusher System) [where applicable].
- b. Appendix A2, Table A2A, Aeroplane FFS - Objective Testing Requirements;
 - 1) Test 2.a.10 (Stick Pusher Force Calibration) [where applicable],
 - 2) Test 2.c.8.a (Stall Characteristics),
 - 3) Test 3.f.5 (Characteristic Motion Vibrations – Stall Buffet) [See paragraph 4 of this section for applicability on previously qualified FSTDs].
- c. Appendix A3, Table A3A, Functions and Subjective Testing Requirements, Test 5.b.1.b (High Angle of Attack Maneuvers); and
- d. Appendix E to this Chapter - Additional Simulator Qualification Requirements for Stall, Upset Prevention and Recovery, and Engine and Airframe Icing Training Tasks (High Angle of Attack Model Evaluation).

7.3.4 For FSTDs initially qualified before effective date of this manual:

- a. Objective testing for stall characteristics (Appendix A2, Table A2A, test 2.c.8.a.) will only be required for the (wings level) second segment climb and approach or landing flight conditions. In lieu of objective testing for the high altitude cruise and turning flight stall conditions, these maneuvers may be subjectively evaluated by a qualified subject matter expert (SME) pilot and addressed in the required statement of compliance.
- b. Where existing flight test validation data in the FSTD's Master Qualification Test Guide (MQTG) are missing required parameters or is otherwise unsuitable to fully meet the objective testing requirements of this Section, Transport Canada may accept alternate sources of validation, including subjective validation by an SME pilot with direct experience in the stall characteristics of the aircraft.
- c. Objective testing for characteristic motion vibrations (Stall buffet – Table A2A, test 3.f.5) is not required where the FSTD's stall buffets have been subjectively evaluated by an SME pilot. For previously qualified Level D FSTDs that currently have objective stall buffet tests in their approved MQTG, the results of these existing tests must be provided to the Transport Canada with the updated stall and stall buffet models in place.
- d. As described in Appendix E to Chapter 6, Transport Canada may accept a statement of compliance from the data provider which confirms the stall characteristics have been subjectively evaluated by an SME pilot on an engineering simulator or development simulator that is acceptable to the FAA. Where this evaluation takes place on an engineering or development simulator, additional objective "proof-of-match" testing for all flight conditions as described in tests 2.c.8.a and 3.f.5 will be required to verify the implementation of the stall model and stall buffets on the training FSTD.

7.3.5 **Sponsor Application.** Where qualification is being sought to conduct full stall training tasks, the FSTD Sponsor must conduct the required evaluations and modifications as prescribed in this Section and report compliance to the MSP in accordance with the procedures in Chapter 3, Section 3.3 (Initial Evaluation) or Section 3.7 (Additional Qualification for a currently qualified FSTD). At a minimum, this letter of intent must be accompanied with the following information:

- a. A description of any modifications to the FSTD necessary to meet the requirements of this Section.

- b. Statements of Compliance (High Angle of Attack Modeling/Stick Pusher System) – See Appendix A1, Table A1A, Section 2.m, 3.f, and Appendix E to this Chapter.
- c. Statement of Compliance (Full Stall) – See Appendix A1, Table A1A, Section 2.m and Appendix E.
- d. Copies of the required objective test results as described above in sections 6.3.4. c, d, and e.

7.4 Aeroplane Full Flight Simulator - Evaluation Requirements for Upset Prevention and Recovery Training Tasks

- 7.4.1 **Applicability.** This section applies to previously qualified aeroplane FFSs being used to obtain training, testing, or checking credits for upset prevention and recovery training tasks (UPRT) as defined in Appendix A1, Table A1A, Section 2.n of this manual. Additionally, FFSs being used for unusual attitude training maneuvers that are intended to exceed the parameters of an aircraft upset must also be evaluated and qualified for UPRT under this section. These parameters include pitch attitudes greater than 25 degrees nose up; pitch attitudes greater than 10 degrees nose down, and bank angles greater than 45 degrees.
- 7.4.2 The requirements contained in this section are intended to define minimum standards for evaluating an FFS for use in upset prevention and recovery training maneuvers that may exceed an aircraft's normal flight envelope. These standards include the evaluation of qualified training maneuvers against the FFS's validation envelope and providing the instructor with minimum feedback tools for the purpose of determining if a training maneuver is conducted within FFS validation limits and the aircraft's operating limits.
- 7.4.3 Where aerodynamic modeling data and/or validation data is not available or insufficient to meet the requirements of this section, the MSP may limit additional qualification to certain upset prevention and recovery maneuvers where adequate data exists.
- 7.4.4 After the effective date of this manual, any FFS being used to obtain training, testing, or checking credit for upset prevention and recovery training tasks in a Transport Canada approved flight training program must be evaluated and issued additional qualification in accordance with this section and the following sections of this manual:
 - a. Appendix A1, Table A1A, - Aeroplane FFS - General Requirements, Section 2.n. (Upset Prevention and Recovery);
 - b. Appendix A3, Table A3A, Aeroplane FFS - Functions and Subjective Testing, Test 5.b.3. (Upset Prevention and Recovery Maneuvers); and
 - c. Appendix E, Aeroplane FFS - Additional Simulator Qualification Requirements for Stall, Upset Prevention and Recovery, and Engine and Airframe Icing Training Tasks (Upset Prevention and Recovery Training Maneuver Evaluation).
- 7.4.5 **Sponsor Application.** Where qualification is being sought to conduct upset prevention and recovery training tasks, the FSTD Sponsor must conduct the required evaluations and modifications as prescribed in this Section and report compliance to the MSP in accordance with the procedures in Chapter 3, Section 3.3 (Initial Evaluation) or Section 3.7 (Additional Qualification for a currently qualified FSTD). At a minimum, this letter of intent must be accompanied with the following information:
 - a. A description of any modifications to the FSTD necessary to meet the requirements of this Section.
 - b. Statement of Compliance (Upset Prevention and Recovery) – See Appendix A1, Table A1A, Section 2.m and Appendix E.

7.5 Aeroplane Full Flight Simulator - Evaluation Requirements for Engine and Airframe Icing Training Tasks

- 7.5.1 **Applicability.** This section applies to previously qualified Level C and Level D FFSs being used to obtain training, testing, or checking credits in maneuvers that demonstrate the effects of engine and airframe ice accretion.
- 7.5.2 The requirements in this section are intended to supersede and improve upon existing Level C and Level D FFS evaluation requirements on the effects of engine and airframe icing. The requirements define a minimum level of fidelity required to adequately simulate the aircraft specific aerodynamic characteristics of an in-flight encounter with engine and airframe ice accretion as necessary to accomplish training objectives.
- 7.5.3 This section contains additional subjective testing that exceeds the evaluation requirements of previously qualified FFSs. Where aerodynamic modeling data is not available or insufficient to meet the requirements of this Directive, the MSP may limit qualified engine and airframe icing maneuvers where sufficient aerodynamic modeling data exists.
- 7.5.4 After the effective date of this manual, any FSTD being used to conduct training tasks that demonstrate the effects of engine and airframe icing must be evaluated and issued additional qualification in accordance with this section and the following sections of this manual:
- a. Appendix A1, Table A1A, Aeroplane FFS - General Requirements, Section 2.j. (Engine and Airframe Icing)
 - b. Appendix E, Aeroplane FFS - Additional Simulator Qualification Requirements for Stall, Upset Prevention and Recovery, and Engine and Airframe Icing Training Tasks (Engine and Airframe Icing Evaluation; Paragraphs 1, 2, and 3).
 - c. Objective demonstration tests of engine and airframe icing effects (Appendix A2, Table A2A, test 2.i. of this Appendix) are not required for previously qualified FSTDs.
- 7.5.5 **Sponsor Application.** Where qualification is being sought to conduct engine and airframe icing training tasks, the FSTD Sponsor must conduct the required evaluations and modifications as prescribed in this Section and report compliance to the MSP in accordance with the procedures in Chapter 3, Section 3.3 (Initial Evaluation) or Section 3.7 (Additional Qualification for a currently qualified FSTD). At a minimum, this letter of intent must be accompanied with the following information:
- a. A description of any modifications to the FSTD necessary to meet the requirements of this section;
 - b. Statement of Compliance (Ice Accretion Model) – See Appendix A1 - Table A1A, Section 2.j, and Appendix E.

7.6 Aeroplane Full Flight Simulator - Evaluation Requirements for Takeoff and Landing in Gusting Crosswind

- 7.6.1 **Applicability.** This section applies to previously qualified FSTDs that will be used to obtain training, testing, or checking credits in takeoff and landing tasks in gusting crosswinds as part of a Transport Canada approved training program. The requirements of this section are applicable only to those Level B and higher FSTDs that are qualified to conduct takeoff and landing training tasks.
- 7.6.2 The requirements in this section introduce new minimum simulator requirements for gusting crosswinds during takeoff and landing training tasks as well as additional subjective testing that exceeds the evaluation requirements of previously qualified FSTDs.

- 7.6.3 After the effective date of this manual, any FSTD that is used to conduct gusting crosswind takeoff and landing training tasks must be evaluated and issued additional qualification in accordance with this section and the following sections of this manual:
- a. Appendix A1, Table A1A, Aeroplane FFS - General Requirements, Section 2.d.3. (Ground Handling Characteristics);
 - b. Appendix A3, Table A3A, Aeroplane FFS - Functions and Subjective Testing Requirements,
 - 1) Test 3.a.3 (Takeoff, Crosswind – Maximum Demonstrated and Gusting Crosswind); and
 - 2) Test 8.d. (Approach and landing with crosswind – Maximum Demonstrated and Gusting Crosswind).
- 7.6.4 **Sponsor Application.** Where qualification is being sought to conduct gusting crosswind training tasks, the FSTD Sponsor must conduct the required evaluations and modifications as prescribed in this Section and report compliance to the MSP in accordance with the procedures in Chapter 3, Section 3.3 (Initial Evaluation) or Section 3.7 (Additional Qualification for a currently qualified FSTD). At a minimum, this letter of intent must be accompanied with the following information:
- a. A description of any modifications to the FSTD (in accordance with § 60.23) necessary to meet the requirements of this Directive.
 - b. Statement of Compliance (Gusting Crosswind Profiles) – See Appendix A1, Table A1A, Section 2.d.3.

7.7 Aeroplane Full Flight Simulator - Evaluation Requirements for Bounced Landing Recovery Training Tasks

- 7.7.1 **Applicability.** This section applies to previously qualified FSTDs that will be used to obtain training, testing, or checking credits in bounced landing recovery as part of an FAA approved training program. The requirements of this Directive are applicable only to those Level B and higher FSTDs that are qualified to conduct takeoff and landing training tasks.
- 7.7.2 The evaluation requirements in this section are intended to introduce new evaluation requirements for bounced landing recovery training tasks and contains additional subjective testing that exceeds the evaluation requirements of previously qualified FSTDs.
- 7.7.3 After the effective date of this manual, any FSTD that is used to conduct bounced landing training tasks must be and issued additional qualification in accordance with this section and the following sections of Appendix A of this Part:
- a. Appendix A1, Table A1A, General Requirements, Section 2.d.2. (Ground Reaction Characteristics)
 - b. Appendix A3, Table A3A, Functions and Subjective Testing Requirements, test 9.e. (Missed Approach – Bounced Landing)
- 7.7.4 **Sponsor Application.** Where qualification is being sought to conduct gusting crosswind training tasks, the FSTD Sponsor must conduct the required evaluations and modifications as prescribed in this Section and report compliance to the MSP in accordance with the procedures in Chapter 3, Section 3.3 (Initial Evaluation) or Section 3.7 (Additional Qualification for a currently qualified FSTD).

7.8 Aeroplane Full Flight Simulator - Procedures and Criteria for Assessing and Approving Circling Approaches

- 7.8.1 Before an aeroplane FFS can be used to train or check pilot proficiency for circling approach procedures and manoeuvres, the visual segment and landing environment of the circling approach must be “functionally and subjectively” assessed. This requirement exists for Levels A, B, C and D

FFS simulators. This section describes the procedures and criteria used by the NSEP during an initial evaluation to assess a FFS's suitability to support circling approach training and checking. It also describes procedures for qualified Minister Delegates to approve additional circling approaches on an ongoing basis to support approved training and checking programs.

7.8.2 **Initial or Upgrade Evaluation.** In order to provide standardized approach, the NSEP has adopted a baseline set of criteria employed by the Federal Aviation Administration (FAA) NSP to subjectively assess a FFS visual system's ability to support training and checking pilot's performance during a circling approach manoeuvre. These criteria are applied during initial evaluations as part of the qualification process. The sponsor is required to prepare **one** Class I or II visual scene of an airport with a circling approach that satisfies the criteria for evaluation purposes. If the functional and subjective assessment for this approach is satisfactory, then the device is deemed to meet the technical requirements of this manual. The following describes the procedures and criteria:

a. **Approach Selection and Setup.** The Sponsor must provide a Class I or II visual scene with a circling approach where:

- 1) the landing runway is equal to or more than 90 degrees and less than 181 degrees off the approach runway heading, and
- 2) The simulator Instructor Operating System (IOS) are set as follows:
 - maximum aircraft landing weight,
 - calm wind,
 - visibility at circling minima, and
 - the ceiling set at circling minima plus 50 ft

Note: if the simulator has the capability of a ragged or "soft" cloud base, deselect this function. If the function cannot be deselected, ensure the ceiling is set high enough to prevent interference from the ragged cloud base.

b. **Circling Manoeuvre Criteria.** This assessment assumes the pilot will execute the manoeuvre within the following parameters:

- 1) The approach is flown as published with the following restrictions on manoeuvring:
 - at no time may the angle of bank exceed 30 degrees,
 - at no time may the rate of descent exceed 1000 fpm,
- 2) Except when the aircraft is in a bank, navigation to the landing runway is accomplished with reference to the runway environment in the visual scene. Blind turns or timed legs and turns are not permitted during the assessment.

Note: The runway environment is considered to be any identifiable landmarks, buildings, roads or lights in the circling area that allows the crew to navigate to the landing runway and need not be the landing runway or the landing runway approach lights themselves, and

- 3) Descent from circling minima does not commence until the aircraft heading is within 30 degrees of the landing runway heading.

c. **Assessment Guidance.** The functions and subjective assessment should focus primarily on the suitability for training. The circling approach criteria has been chosen to represent the sufficiently challenging geometry to assess whether the visual system allows the pilot to **visually** execute the manoeuvre while adhering to the manoeuvre criteria. The inspector should consider the following for all scene configurations (day, dawn, dusk and night):

- 1) Whether there is sufficient scene content to support the circling manoeuvre,
- 2) Whether the IOS settings (and any presets) configure the ceiling and visibility appropriately to allow visual acquisition and manoeuvring at approach minima.

- 3) Whether the approach lighting is representative, and can be sufficiently controlled through the IOS to facilitate training.
- 4) Any “tuning” anomalies or scene content deficiencies must be recorded in the evaluation report and / or defect log. If the scene content must be adjusted through a software database change, then the scene should not be approved for circling until the new version is released and reassessed.

7.8.3 Approving Additional Scenes for Circling Approaches. Although a simulator may meet the technical requirement for circling approaches after its initial evaluation, it does not mean that all visual scenes available on the simulator can support circling approaches. Some limitations may exist in specific scene-databases that limit the field of view, scene content and the ability to configure the runway lighting environment to support a fair training and checking environment for a particular approach. Therefore, it is necessary that each specific circling approach intended for use for pilot training and checking in an approved training program be verified by a qualified Transport Canada representative. The following provides the procedures for Sponsors seeking approval for additional circling approaches:

- a. **Authority.** Once the FFS has been qualified by the NSEP for circling approaches, additional scenes and approaches may be verified and approved by a Transport Canada Civil Aviation Inspector (CAI) or a Transport Canada Approved Check Pilot (ACP).

Note: The authority for approving additional scenes does not reside solely within the simulator qualification process; it is shared with the Training Program Approving Authority (TPAA) who has the mandate to monitor and approve training programs pursuant to the Canadian Aviation Regulations (CARs_. (See Chapter 2, Section 2.3 for TPAA responsibilities).

- b. **Procedural Guidelines.** The following are procedural guidelines for ACI and ACPs:

CAIs and ACPs may approve any circling scene on behalf of the TPAA when required to support an approved training and checking program. The approach geometry does **not** have to conform to the geometry criteria at para 7.8.2a1), since this criteria may exclude some approaches required in an approved training program. The TPAA is the final authority to determine whether the approach geometry satisfies Pilot Proficiency Check (PPC) requirements.

- 1) The visual scene used for the circling approach must be either a Class I or II scene with sufficient scene content to acquire the approach runway and to execute the circling manoeuvre to the landing runway.

Note: Class III scenes are not permitted for PPCs but may be approved for special circling approach training only provided the scene is approved by the TPAA in accordance with the QPS provisions at Chapter 4, Section 4.13, para 4.13.7.

- 2) During the assessment, the approach must be flown according to the criteria at para 7.8.2b.
- 3) The CAI or ACP should adhere to the assessment guidance provided at para 7.8.2c.
- 4) The CAI or ACP will advise the MSP by letter and forward a copy to the TPAA and the simulator Sponsor (operator). The letter will contain the following:
- 5) The Approach name - (i.e. CYOW LOC Rwy 07 Circle to Rwy 32)
- 6) Simulator Sponsor - (i.e. CAE Toronto Training Centre)
- 7) Simulator ID – (i.e. TCID 498, DHC8-400)
- 8) Visual System – (i.e. CAE TROPOS 6000)
- 9) Visual Scene Class – (YOW Class II)
- 10) IOS Setting used:– (i.e. ceiling/visibility settings or presets; runway light strength; day or night; wind; surface temperature; cloud type, any special instructions to enable landing runway environment)

11) Name of the Training Program Approving Authority (typically the POI).

Note: The TPAA may request the NSEP to approve an approach during the next scheduled recurrent if this is convenient,

- c. The approach is approved once the CAI or ACP completes a satisfactory assessment. Upon receipt of the CAI or ACP letter, the MSP will forward a letter to the Sponsor confirming that the approach is approved. The Sponsor is responsible for maintaining a record of additional approach approvals (not listed on the FSTD Qualification Certificate) and present the list of approved approaches for Canadian users in an appropriate manner near the FFS.

Appendix G1 - Additional Simulator Qualification Requirements for Stall, Upset Prevention and Recovery, and Engine and Airframe Icing Training Tasks

A. High Angle of Attack Model Evaluation (Appendix A1, Table A1A, Section 2.m.)

1. **Applicability:** This Appendix applies to all aeroplane simulators that are used to satisfy training requirements for stall maneuvers that are conducted at angles of attack beyond the activation of the stall warning system. This Appendix is not applicable for those FSTDs that are only qualified for approach to stall maneuvers where recovery is initiated at the first indication of the stall. The material in this section is intended to supplement the general requirements, objective testing requirements, and subjective testing requirements contained within Tables A1A, A2A, and A3A, of Appendices A1, A2 and A3 respectively.
2. **General Requirements:** The requirements for high angle of attack modeling are intended to evaluate the recognition cues and performance and handling qualities of a developing stall through the stall identification angle-of-attack and recovery. Strict time-history-based evaluations against flight test data may not adequately validate the aerodynamic model in an unsteady and potentially unstable flight regime, such as stalled flight. As a result, the objective testing requirements defined in Appendix A2, Table A2A do not prescribe strict tolerances on any parameter at angles of attack beyond the stall identification angle of attack. In lieu of mandating such objective tolerances, a Statement of Compliance (SOC) will be required to define the source data and methods used to develop the stall aerodynamic model.
3. **Fidelity Requirements:** The requirements defined for the evaluation of full stall training maneuvers are intended to provide the following levels of fidelity:
 - a. Airplane type specific recognition cues of the first indication of the stall (such as the stall warning system or aerodynamic stall buffet);
 - b. Airplane 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 airplane being simulated to allow successful completion of the stall recovery training tasks.

For the purposes of stall maneuver evaluation, the term “exemplar” is defined as a level of fidelity that is type specific of the simulated aeroplane to the extent that the training objectives can be satisfactorily accomplished.

4. **Statement of Compliance (Aerodynamic Model):** At a minimum, the SOC must address the following:
 - a. **Source Data and Modeling Methods:** The SOC must identify the sources of data used to develop the aerodynamic model. These data sources may be from the airplane original equipment manufacturer (OEM), the original FSTD manufacturer/data provider, or other data provider acceptable to the FAA. 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 aircraft configurations. For the flight test data, a list of the types of maneuvers 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 it is impractical to develop and validate a stall model with flight-test data (e.g., due to safety concerns involving the collection of flight test data past a certain angle of attack), the data provider is expected to make a reasonable attempt to develop a stall model through the required angle of attack range using analytical methods and empirical data (e.g., wind-tunnel data);
 - b. **Validity Range:** The FSTD sponsor must declare the range of angle of attack and sideslip where the aerodynamic model remains valid for training. For stall recovery training tasks, satisfactory aerodynamic model fidelity must be shown through at least 10 degrees beyond the stall identification angle of attack. For the purposes of determining this validity range, the stall identification angle of attack is defined as the angle of attack where the pilot is given a clear and distinctive indication to cease any further increase in angle of attack where one or more of the following characteristics occur:

- 1) No further increase in pitch occurs when the pitch control is held at the full aft stop for 2 seconds, leading to an inability to arrest descent rate;
- 2) An uncommanded nose down pitch that cannot be readily arrested, which may be accompanied by an uncommanded rolling motion;
- 3) Buffeting of a magnitude and severity that is a strong and effective deterrent to further increase in angle of attack; and
- 4) Activation of a stick pusher.

The model validity range must also be capable of simulating the airplane dynamics as a result of a pilot initially resisting the stick pusher in training. For aircraft equipped with a stall envelope protection system, the model validity range must extend to 10 degrees of angle of attack beyond the stall identification angle of attack with the protection systems disabled or otherwise degraded (such as a degraded flight control mode as a result of a pitot/static system failure).

- c. **Model Characteristics:** Within the declared range of model validity, the SOC must address, and the aerodynamic model must incorporate, the following stall characteristics where applicable by aircraft type:
 - 5) Degradation in static/dynamic lateral-directional stability;
 - 6) Degradation in control response (pitch, roll, yaw);
 - 7) Uncommanded roll acceleration or roll-off requiring significant control deflection to counter;
 - 8) Apparent randomness or non-repeatability;
 - 9) Changes in pitch stability;
 - 10) Stall hysteresis;
 - 11) Mach effects;
 - 12) Stall buffet; and
 - 13) Angle of attack rate effects.

An overview of the methodology used to address these features must be provided.

5. **Statement of Compliance (Subject Matter Expert Pilot Evaluation):** The sponsor must provide an SOC that confirms the FSTD has been subjectively evaluated by a subject matter expert (SME) pilot who is knowledgeable of the aircraft's stall characteristics. In order to qualify as an acceptable SME to evaluate the FSTD's stall characteristics, the SME must meet the following requirements:
 - a. Has held a type rating/qualification in the aircraft being simulated;
 - b. Has direct experience in conducting stall maneuvers in an aircraft that shares the same type rating as the make, model, and series of the simulated aircraft. This stall experience must include hands on manipulation of the controls at angles of attack sufficient to identify the stall (e.g., deterrent buffet, stick pusher activation, etc.) through recovery to stable flight;
 - c. Where the SME's stall experience is on an airplane of a different make, model, and series within the same type rating, differences in aircraft specific stall recognition cues and handling characteristics must be addressed using available documentation. This documentation may include aircraft operating manuals, aircraft manufacturer flight test reports, or other documentation that describes the stall characteristics of the aircraft; and
 - d. Must be familiar with the intended stall training maneuvers to be conducted in the FSTD (e.g., general aircraft configurations, stall entry methods, etc.) and the cues necessary to accomplish the required training objectives. The purpose of this requirement is to ensure that the stall model has been sufficiently evaluated in those general aircraft configurations and stall entry methods that will likely be conducted in training.
6. This SOC will only be required once at the time the FSTD is initially qualified for stall training tasks as long as the FSTD's stall model remains unmodified from what was originally evaluated and qualified. Where an FSTD shares common aerodynamic and flight control models with that of an engineering or development simulator, Transport Canada will accept a SOC from the data provider that confirms the stall characteristics have been subjectively assessed by an SME pilot on the engineering simulator.
7. An FSTD sponsor may submit a request to the MSP for approval of a deviation from the SME pilot experience requirements in this paragraph. This request for deviation must include the following information:

- a. An assessment of pilot availability that demonstrates that a suitably qualified pilot meeting the experience requirements of this section cannot be practically located; and
- b. Alternative methods to subjectively evaluate the FSTD's capability to provide the stall recognition cues and handling characteristics needed to accomplish the training objectives.

B. Upset Prevention and Recovery Training Maneuver Evaluation (Appendix A1, Table A1A, Section 2.n.)

1. **Applicability:** This attachment applies to all simulators that are used to satisfy training requirements for upset prevention and recovery training (UPRT) maneuvers. For the purposes of this Appendix (as defined in the Airplane Upset Recovery Training Aid), an aircraft upset is generally defined as an airplane unintentionally exceeding the following parameters normally experienced in line operations or training:

- a. Pitch attitude greater than 25 degrees nose up;
- b. Pitch attitude greater than 10 degrees nose down;
- c. Bank angles greater than 45 degrees; and
- d. Within the above parameters, but flying at airspeeds inappropriate for the conditions.

FSTDs that will be used to conduct training maneuvers where the FSTD is either repositioned into an aircraft upset condition or an artificial stimulus (such as weather phenomena or system failures) is applied that is intended to result in a flight-crew entering an aircraft upset condition must be evaluated and qualified in accordance with this section.

2. **General Requirements:** The general requirement for UPRT qualification in Appendix A1, Table A1A defines three basic elements required for qualifying an FSTD for UPRT maneuvers:

- a. **FSTD Training Envelope:** Valid UPRT should be conducted within the high and moderate confidence regions of the FSTD validation envelope as defined in paragraph 3 below.
- b. **Instructor Feedback:** Provides the instructor/evaluator with a minimum set of feedback tools to properly evaluate the trainee's performance in accomplishing an upset recovery training task.
- c. **Upset Scenarios:** Where dynamic upset scenarios or aircraft system malfunctions are used to stimulate the FSTD into an aircraft upset condition, specific guidance must be available to the instructor on the IOS that describes how the upset scenario is driven along with any malfunction or degradation in FSTD functionality that is required to stimulate the upset.

3. Flight Simulation Training Device **Validation Envelope:** This envelope is defined by the following 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 simulator responds similarly to the aircraft. 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 or the use of other reliable predictive methods (typically by the aircraft manufacturer) to define the aerodynamic model. Any extensions to the aerodynamic model that have been evaluated in accordance with the definition of an exemplar stall model (as described in the stall maneuver evaluation section) must be clearly indicated. Within this region, there is moderate confidence that the simulator will respond similarly to the aircraft.
- c. **Extrapolated:** 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. Whether this extrapolated data is provided by the aircraft or simulator manufacturer, it is a "best guess" only. Within this region, there is low confidence that the simulator will respond similarly to the aircraft. 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 aircraft.

4. **Instructor Feedback Mechanism:** For the instructor/evaluator to provide feedback to the student during UPRT maneuver training, additional information must be accessible that indicates the fidelity of the simulation, the magnitude of trainee's flight control inputs, and aircraft operational limits that could potentially affect the

successful completion of the maneuver(s). At a minimum, the following must be available to the instructor/evaluator:

- a. **FSTD Validation Envelope:** The FSTD must employ a method to display the FSTD's expected fidelity with respect to the FSTD validation envelope. This may be displayed as an angle of attack vs sideslip (alpha/beta) envelope cross-plot on the IOS or other alternate method to clearly convey the FSTD's fidelity level during the maneuver. The cross-plot or other alternative method must display the relevant validity regions for flaps up and flaps down at a minimum. This validation envelope must be derived by the aerodynamic data provider or derived using information and data sources provided by the original aerodynamic data provider.
- b. **Flight Control Inputs:** The FSTD must employ a method for the instructor/evaluator to assess the trainee's flight control inputs during the upset recovery maneuver. 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 aircraft, must be portrayed in this feedback mechanism as well. For passive side-sticks, whose displacement is the flight control input, the force applied by the pilot to the controls does not need to be displayed. This tool must include a time history or other equivalent method of recording flight control positions.
- c. **Aircraft Operational Limits:** The FSTD must employ a method to provide the instructor/evaluator with real-time information concerning the aircraft operating limits. The simulated aircraft's parameters must be displayed dynamically in real-time and also provided in a time history or equivalent format. At a minimum, the following parameters must be available to the instructor:
 - 14) Airspeed and airspeed limits, including the stall speed and maximum operating limit airspeed (V_{mo}/M_{mo});
 - 15) Load factor and operational load factor limits; and
 - 16) Angle of attack and the stall identification angle of attack. See section A, paragraph 4.b. of this attachment for additional information concerning the definition of the stall identification angle of attack. This parameter may be displayed in conjunction with the FSTD validation envelope.

An example FSTD "alpha/beta" envelope display and IOS feedback mechanism are shown below in Figure 1 and Figure 2. The following examples are provided as guidance material on one possible method to display the required UPRT feedback parameters on an IOS display. FSTD sponsors may develop other methods and feedback mechanisms that provide the required parameters and support the training program objectives.

Figure 1 – Example FSTD Alpha/Beta Envelope Plot

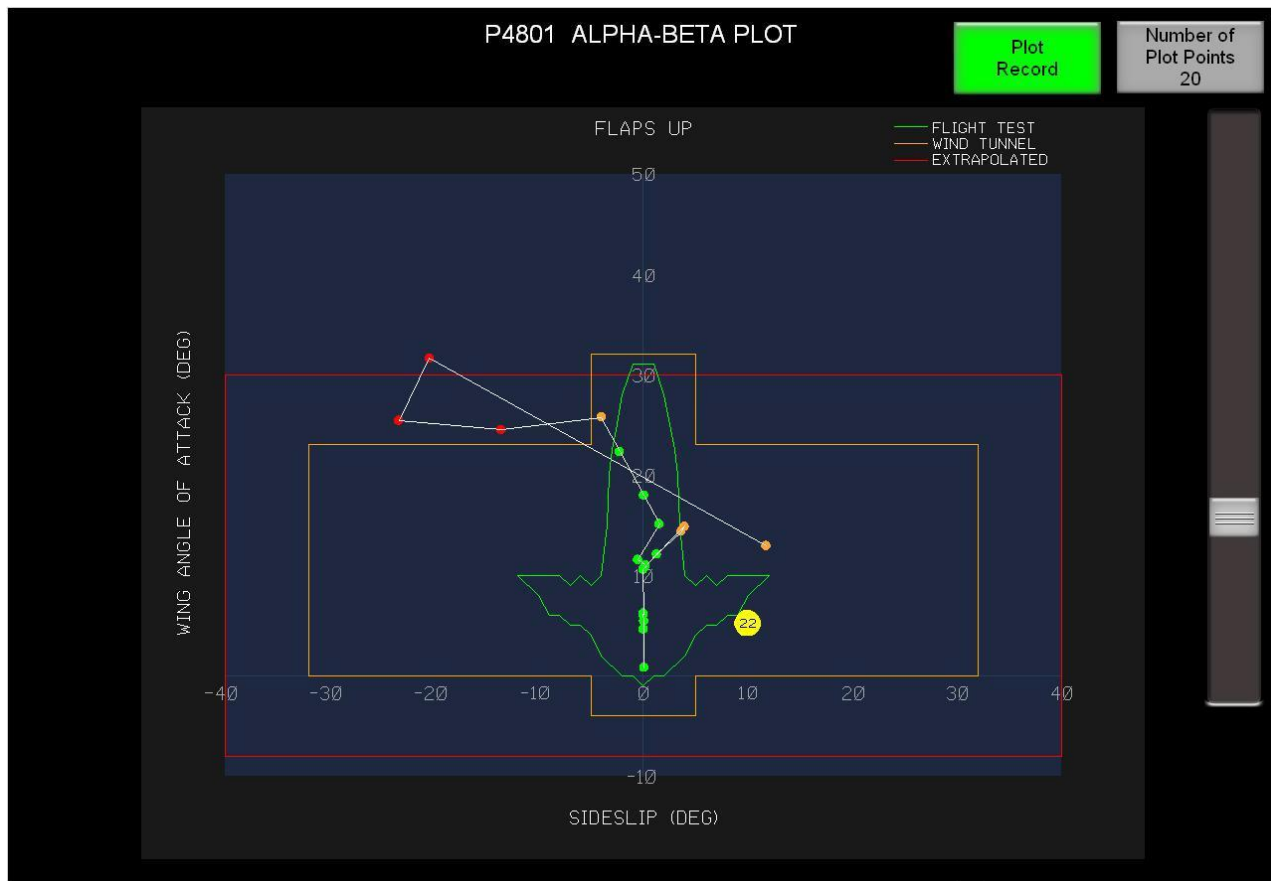
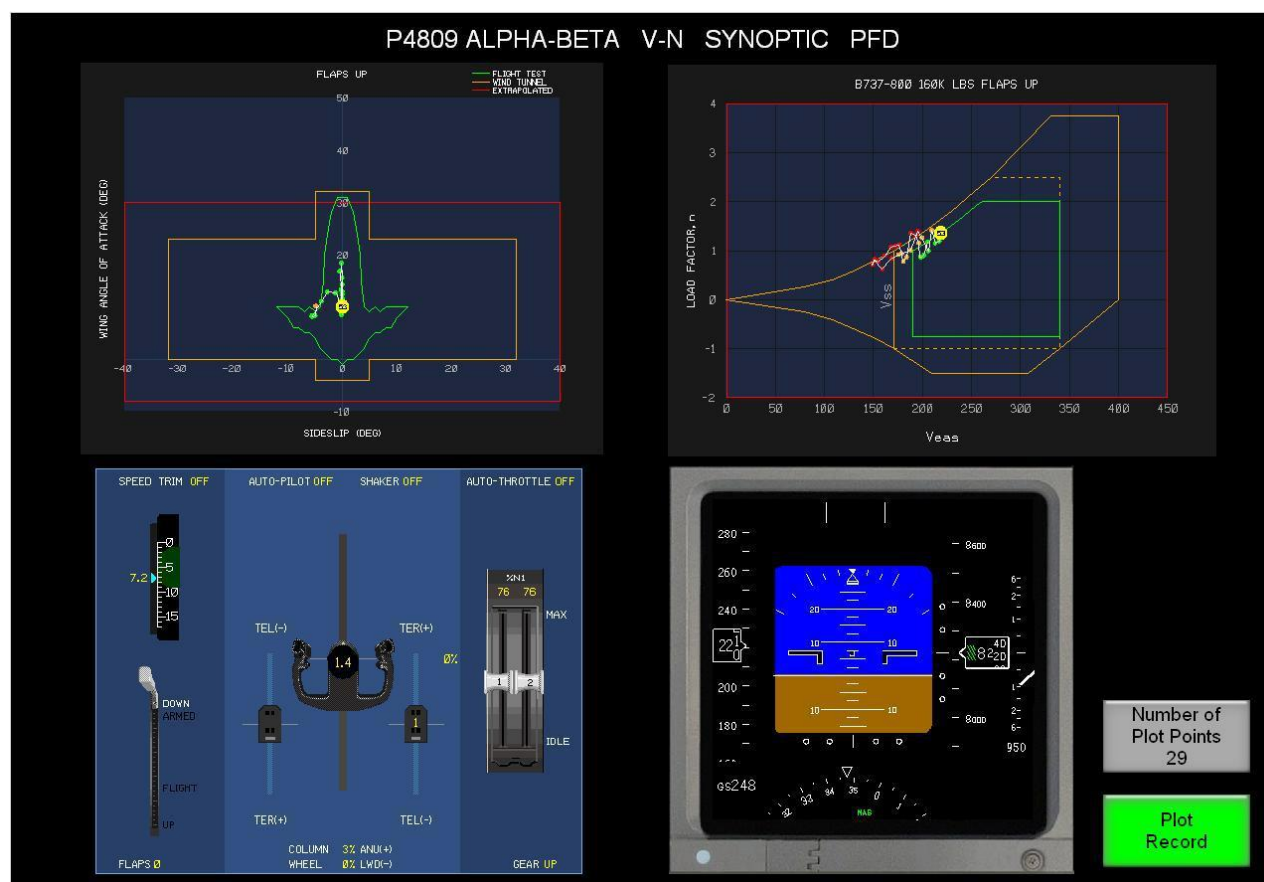


Figure 2 – Example IOS Instructor UPRT Feedback Display



C. Engine and Airframe Icing Evaluation (Appendix A1, Table A1A, Section 2.j.)

1. **Applicability:** 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 simulator qualification have been developed to define aircraft specific icing models that support training objectives for the recognition and recovery from an in-flight ice accretion event.
2. **General Requirements:** The qualification of engine and airframe icing consists of the following elements that must be considered when developing ice accretion models for use in training:
 - a. Ice accretion models must be developed to account for training the specific skills required for recognition of ice accumulation and execution of the required response.
 - b. Ice accretion models must be developed in a manner to contain aircraft specific recognition cues as determined with aircraft OEM supplied data or other suitable analytical methods.
 - c. At least one qualified ice accretion model must be objectively tested to demonstrate that the model has been implemented correctly and generates the correct cues as necessary for training.
3. **Statement of Compliance:** The SOC as described in Appendix A1, Table A1A, Section 2.j. must contain the following information to support FSTD qualification of aircraft specific ice accretion models:
 - a. A description of expected aircraft specific recognition cues and degradation effects due to a typical in-flight icing encounter. Typical cues may include loss of lift, decrease in stall angle of attack, changes in pitching moment, decrease in control effectiveness, and changes in control forces in addition to any overall increase in drag. This description must be based upon relevant source data, such as aircraft OEM supplied data, accident/incident data, or other acceptable data sources. Where a particular airframe has demonstrated vulnerabilities to a specific type of ice accretion (due to accident/incident history) which requires specific training (such as supercooled large-droplet icing or tailplane icing), ice accretion models must be developed that address the training requirements.

- 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, aircraft certification data, aircraft OEM engineering simulation data, or other analytical methods based upon established engineering principles.
- 4. **Objective Demonstration Testing:** The purpose of the objective demonstration test is to demonstrate that the ice accretion models as described in the Statement of Compliance have been implemented correctly and demonstrate the proper cues and effects as defined in the approved data sources. At least one ice accretion model must be selected for testing and included in the Master Qualification Test Guide (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.
 - a. **Recorded Parameters:** In each of the two required MQTG cases, a time history recording must be made of the following parameters:
 - i. Altitude;
 - 17) Airspeed;
 - 18) Normal Acceleration;
 - 19) Engine Power/settings;
 - 20) Angle of Attack/Pitch attitude;
 - 21) Bank Angle;
 - 22) Flight control inputs;
 - 23) Stall warning and stall buffet onset; and
 - 24) Other parameters as necessary to demonstrate the effects of ice accretions.
 - b. **Demonstration maneuver:** The FSTD sponsor must select an ice accretion model as identified in the SOC for testing. The selected maneuver must 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 buildup) test. The ice accretion models must demonstrate the cues necessary to recognize the onset of ice accretion on the airframe, lifting surfaces, and engines and provide representative degradation in performance and handling qualities to the extent that a recovery can be executed. Typical recognition cues that may be present depending upon the simulated aircraft include:
 - 25) Decrease in stall angle of attack;
 - 26) Increase in stall speed;
 - 27) Increase in stall buffet threshold of perception speed;
 - 28) Changes in pitching moment;
 - 29) Changes in stall buffet characteristics;
 - 30) Changes in control effectiveness or control forces; and
 - 31) Engine effects (power variation, vibration, etc.);

The demonstration test may be conducted by initializing and maintaining a fixed amount of ice accretion throughout the maneuver in order to consistently evaluate the aerodynamic effects.