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Flight Simulation Training Device Qualification Standards for Extended Envelope and Adverse Weather Event Training Tasks; Proposed Rule

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 60

[Docket No.: FAA–2014–0391; Notice No. 2014–04]

RIN 2120–AK08

Flight Simulation Training Device Qualification Standards for Extended Envelope and Adverse Weather Event Training Tasks

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: The FAA proposes to amend the Qualification Performance Standards for flight simulation training devices (FSTDs) for the primary purpose of improving existing technical standards and introducing new technical standards for evaluating an FSTD for full stall and stick pusher maneuvers, upset recognition and recovery maneuvers, maneuvers conducted in airborne icing conditions, takeoff and landing maneuvers in gusting crosswinds, and bounced landing recovery maneuvers. These new and improved technical standards are intended to fully define FSTD fidelity requirements for conducting new flight training tasks introduced through recent changes in the air carrier training requirements as well as to address various National Transportation Safety Board and Aviation Rulemaking Committee recommendations. The proposal also updates the FSTD technical standards to better align with the current international FSTD evaluation guidance and introduces a new FSTD level that expands the number of qualified flight training tasks in a fixed-base flight training device. The proposed changes would ensure that the training and testing environment is accurate and realistic, would codify existing practice, and would provide greater harmonization with international guidance for simulation. With the exception of the proposal to codify new FSTD technical standards for specific training tasks through an FSTD Directive, the proposed amendments would not apply to previously qualified FSTDs.

DATES: Send comments on or before October 8, 2014.

ADDRESSES: Send comments identified by docket number FAA–2014–0391 using any of the following methods:

- *Federal eRulemaking Portal:* Go to *http://www.regulations.gov* and follow the online instructions for sending your comments electronically.
- *Mail:* Send comments to Docket Operations, M–30; U.S. Department of Transportation (DOT), 1200 New Jersey Avenue SE., Room W12–140, West Building Ground Floor, Washington, DC 20590–0001.
- *Hand Delivery or Courier:* Take comments to Docket Operations in Room W12–140 of the West Building Ground Floor at 1200 New Jersey Avenue SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.
- *Fax:* Fax comments to Docket Operations at 202–493–2251.

Privacy: In accordance with 5 U.S.C. 553(c), DOT solicits comments from the public to better inform its rulemaking process. DOT posts these comments, without edit, including any personal information the commenter provides, to *www.regulations.gov*, as described in the system of records notice (DOT/ALL–14 FDMS), which can be reviewed at *www.dot.gov/privacy.*

Docket: Background documents or comments received may be read at *http://www.regulations.gov* at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12–140 of the West Building Ground Floor at 1200 New Jersey Avenue SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: For technical questions concerning this action, contact Larry McDonald, Air Transportation Division/National Simulator Program Branch, AFS–205, Federal Aviation Administration, P.O. Box 20636, Atlanta, GA 30320; telephone (404) 474–5620; email *larry.e.mcdonald@faa.gov.*

For legal questions concerning this action, contact Robert H. Frenzel, Manager, Operations Law Branch, Office of the Chief Counsel, Regulations Division (AGC–200), Federal Aviation Administration, 800 Independence Avenue SW., Washington, DC 20591; telephone (202) 267–3073; email *Robert.Frenzel@faa.gov.*

SUPPLEMENTARY INFORMATION:

Authority for This Rulemaking

The Federal Aviation Administration's (FAA's) authority to issue rules on aviation safety is found in Title 49 of the United States Code. Subtitle I, Section 106(f) describes the authority of the FAA Administrator. Subtitle VII, Aviation Programs, describes in more detail the scope of the agency's authority.

This rulemaking is promulgated under the authority described in 49 U.S.C. 44701(a)(5), which requires the Administrator to promulgate regulations and minimum standards for other practices, methods, and procedures necessary for safety in air commerce and national security. This amendment to the regulation is within the scope of that authority because it prescribes an accepted method for testing and evaluating flight simulation training devices used to train and evaluate flightcrew members.

In addition, the Airline Safety and Federal Aviation Administration Extension Act of 2010 (Pub. L. 111–216) specifically required the FAA to conduct rulemaking to ensure that all flightcrew members receive flight training in recognizing and avoiding stalls, recovering from stalls, and recognizing and avoiding upset of an aircraft, as well as the proper techniques to recover from upset. This rulemaking is within the scope of the authority in Public Law 111–216 and is necessary to fully implement the training requirements recently adopted in the Qualification, Service, and Use of Crewmembers and Aircraft Dispatchers final rule (Crewmember and Aircraft Dispatcher Training Final Rule), RIN 2120–AJ00. See 78 FR 67800 (Nov. 12, 2013).

List of Abbreviations and Acronyms Frequently Used in This Document

AC—Advisory Circular
ARC—Aviation Rulemaking Committee
AURTA—Airplane Upset Recovery Training Aid
FFS—Full Flight Simulator
FTD—Flight Training Device
FSTD—Flight Simulation Training Device
ICATEE—International Committee on Aviation Training in Extended Envelopes
LOCART—Loss of Control Avoidance and Recovery Training Working Group
NPRM—Notice of Proposed Rulemaking
QPS—Qualification performance standards
SNPRM—Supplemental Notice of Proposed Rulemaking
SPAW ARC—Stick Pusher and Adverse Weather Event Training Aviation Rulemaking Committee

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I. Executive Summary

The primary purpose of this proposal is to define simulator fidelity requirements for new training tasks that were mandated for air carrier training programs by Public Law 111–216. The notice of proposed rulemaking (NPRM) proposes to accomplish this by establishing new or updated Flight Simulation Training Device (FSTD) technical evaluation standards for full stall and upset recognition and recovery training tasks as required in the Crewmember and Aircraft Dispatcher Training Final Rule and as proposed by the Stick Pusher and Adverse Weather Event Training ARC (SPAW ARC).

The Crewmember and Aircraft Dispatcher Training Final Rule added training requirements for pilots that target the prevention of and recovery from stall and upset conditions, recovery from bounced landings, enhanced runway safety training, and enhanced training on crosswind takeoffs and landings with gusts. Stall and upset prevention requires pilot skill in manual handling maneuvers and procedures. Therefore, the manual handling maneuvers most critical to stall and upset prevention (i.e., slow flight, loss of reliable airspeed, and manually controlled departure and arrival) are included as part of the agency's overall stall and upset mitigation strategy. These maneuvers are identified in the Crewmember and Aircraft Dispatcher Training Final Rule within the ''extended envelope'' training provision, which further requires that these maneuvers be completed in an FSTD. As a result, revisions to all part 121 training programs will be necessary and revisions to part 60 will be required to fully implement the extended envelope, bounced landing, and gusty crosswinds flight training required by the Crewmember and Aircraft Dispatcher Training Final Rule.

In addition, this proposal addresses a potential lack of simulator fidelity as identified in several NTSB safety recommendations and Aviation Rulemaking Committee (ARC) recommendations concerning flight training tasks, such as anti-icing, bounced landing, gusty crosswind, and extended envelope training. These changes are necessary to ensure a realistic crew training environment and to prevent incorrect simulator training.

For the purpose of this rulemaking, the term ''extended envelope training tasks'' (such as full stall and aircraft upset recovery) refers to maneuvers and procedures conducted in a FSTD that may extend beyond the limits where typical FSTD performance and handling qualities have been validated with heavy reliance on flight data to represent the actual aircraft. In instances when obtaining such flight data is hazardous or impractical, engineering predictive methods and subject-matter-expert assessment are used to program and validate the aircraft's behavior in the simulator.

The secondary purpose of this NPRM is to align the technical standards for Level C and D (fixed wing) FSTDs that are defined in Title 14 of the Code of Federal Regulations (CFR) Part 60 with the current international FSTD evaluation guidelines published in the International Civil Aviation Organization (ICAO) document 9625 Edition 3, *Manual of Criteria for the Qualification of Flight Simulation Training Devices* (ICAO 9625, Edition 3). These changes would incorporate the technical guidelines for the highest level of ICAO-defined FSTD (Type VII) into the part 60 Level C and Level D FSTD standards, where appropriate. This proposal also introduces a new level of fixed-wing FSTD (a Level 7 flight training device (FTD)) that is based upon the ICAO 9625, Edition 3, Type V FSTD technical guidance. Changes intended to align with the ICAO guidance would address new aircraft and simulation technology introduced since the original issuance of part 60, incorporate general improvements to the FSTD evaluation standards, and provide air carriers and flight training providers with additional options for conducting approved training tasks in an FTD as opposed to a more costly full flight simulator (FFS).

In general, the proposed changes to the technical standards would apply only to those FSTDs that are initially qualified or upgraded in qualification level after the final rule becomes effective. For previously qualified FSTDs used to conduct extended envelope, airborne icing, gusting crosswind, and bounced landing training, the FAA is also seeking comment on a proposed FSTD Directive that would require FSTD Sponsors to retroactively evaluate those FSTDs against certain objective and subjective testing requirements as defined in the QPS appendices and modify them if necessary to meet the proposed requirements. This proposed FSTD Directive would be applicable to any FSTD being used to conduct these training tasks, including those FSTDs being used to conduct such training on a voluntary basis in a non-air carrier flight training program. Those previously qualified devices that would not be used to conduct these specified training tasks would not require modification or evaluation.

For all FSTDs that are initially qualified or upgraded in qualification level after implementation of these regulations, the proposed changes to the

QPS appendices would become effective 30 days after publication of a final rule. However, new FSTDs may still be initially qualified under existing standards after this date, subject to up to a 24 month grace period as currently defined in § 60.15(c). For previously qualified FSTDs that will be used to conduct certain extended envelope and other training tasks described in the Crewmember and Dispatcher Training Final Rule, compliance with the proposed FSTD Directive would be required within three years of the publication date of a final rule implementing these provisions. The FAA is seeking comment on these proposed compliance dates.

A summary of the cost and benefit information is presented below.

		Present Value at a 7% Rate	Present Value at a 3% Rate
Total Cost	$52,378,480	$36,894,514	$44,892,676
Upgrade FSTDs for New Training Requirements			
Cost	$45,215,480	$32,286,867	$39,014,931
Benefits	Justified by the benefits of the training rule.		
Icing provisions			
Cost [1]	$468,000	$334,183	$403,822
Benefits	Only one prevented serious injury valued at $965,724 makes the icing benefits exceed the costs.		
Aligning Standards with ICAO			
Cost	$6,695,000	$4,273,464	$5,473,924
Benefits	Improved safety and cost savings		

[1] Implementing the icing upgrades can be accomplished at the same time as the non-icing upgrades. Therefore these estimates do not include the cost of implementation or FSTD downtime because these costs are included with the costs of the non-icing upgrades.
Note: Details may not add to row or column totals due to rounding

II. Background

A. Statement of the Problem

In order to mitigate aircraft loss of control accidents and to comply with the requirements of Public Law 111–216, the FAA has required new or revised flight training requirements in the Crewmember and Aircraft Dispatcher Training Final Rule for flight maneuvers such as full stall and upset recovery training. Through participation with various industry working groups and recommendations received from the SPAW ARC, the FAA determined that many existing FSTDs used by air carriers to conduct such training may not adequately represent the simulated aircraft to a degree necessary for successful completion of required training tasks. Additionally, the FAA evaluated several recent air carrier accidents and determined that low FSTD fidelity or the lack of ability for an FSTD to adequately conduct certain training tasks may have been a contributing factor in these accidents. A potential lack of simulator fidelity could contribute to inaccurate or incomplete training on new training tasks that are required by the Crewmember and Aircraft Dispatcher Training Final Rule, which could lead to an associated and unnecessary safety risk.

Furthermore, since the initial publication of the part 60 final rule in 2008, the international FSTD qualification guidance published in ICAO 9625, Edition 3 have been updated to incorporate general improvements to new aircraft and simulation technology and the introduction of new FSTD levels that better align FSTD fidelity with required training tasks. The ICAO 9625 document is an internationally recognized set of FSTD evaluation guidelines that was developed by a wide range of government and industry experts on flight simulation training and technology and has been used as a basis for national regulation and guidance material for FSTD evaluation in many countries. Internationally aligned FSTD standards facilitate cost savings for FSTD operators because they effectively reduce the number of different FSTD designs that are required to meet multiple national regulations and standards for FSTD qualification.

The proposals in this NPRM were largely developed using recommendations from the SPAW ARC [1] and the international FSTD qualification guidelines that are published in ICAO Document 9625, Edition 3.[2] These proposals are primarily directed at improving the fidelity of FSTDs that would be used in air carrier pilot training. They would also have an added benefit of improving the fidelity of all FSTDs qualified after the proposed rule becomes effective.

[1] A copy of the SPAW ARC final report has been placed in the docket for this rulemaking.

[2] International Civil Aviation Organization (ICAO) publications can be located on their public internet site at: *http://www.icao.int/.*

B. History

1. Industry Stall and Stick Pusher Working Group

In March 2010, the FAA worked with industry leaders to address concerns arising from the increase in stall and loss of control accidents. The Stall and Stick Pusher Working Group met over a 9 month period and produced many training recommendations to prevent stall events. This working group included members from aircraft manufacturers, simulator manufacturers, training companies, pilot associations, airlines, and the FAA.

In addition to providing best training practices using current simulation, the working group recommended that simulators in use today should not be used for training to or past the aerodynamic stall unless further testing and validation in that flight regime are performed for the specific simulator and approved by the FAA. This working group did not recommend post-stall training because the roll and yaw characteristics and the stall buffet characteristics of the simulator may not be representative of the aircraft.

2. International Committee on Aviation Training in Extended Envelopes (ICATEE)

In 2009, the Royal Aeronautical Society formed the International Committee on Aviation Training in Extended Envelopes (ICATEE) working group to examine aircraft upset recovery training and recommend improvements to both training and simulation devices used to conduct training. This working group was comprised of subject matter experts in many facets of industry and government including airlines, flight training providers, research entities, FSTD manufacturers, airframe manufacturers, regulatory authorities, and airline pilots associations. The ICATEE working methodology was to first conduct a training needs analysis using subject matter experts in the area of pilot training and then determine the training device requirements as a function of the identified training needs. Once the training needs were established, subject matter experts in FSTD technology developed proposed modifications to the FSTD qualification standards to support the recommended training tasks. While the ICATEE final report has not been published yet, several interim recommendations from ICATEE on FSTD technical evaluation standards for stall, upset recovery, and airborne icing maneuvers were provided to the SPAW ARC for consideration in developing its recommendations.

3. Airline Safety and Federal Aviation Administration Extension Act of 2010 (Pub. L. 111–216)

On August 1, 2010, President Obama signed into law Public Law 111–216. In addition to extending the FAA's authorization, Public Law 111–216 included provisions to improve airline safety and pilot training. Specifically, section 208 of Public Law 111–216, Implementation of NTSB Flight Crewmember Training Recommendations, pertains directly to this rulemaking in that stall training and upset recovery training were mandated for part 121 air carrier flightcrew members.

4. Crewmember and Aircraft Dispatcher Training Final Rule

On November 12, 2013, the FAA published the Crewmember and Aircraft Dispatcher Training Final Rule, adding the training tasks required by Public Law 111–216, specifically targeting extended envelope training, recovery from bounced landings, enhanced runway safety training, and enhanced training on crosswind takeoffs and landings with gusts which further requires that these maneuvers be completed in an FSTD. As a result, revisions to all part 121 training programs will be necessary and the revisions to part 60 as proposed in this rule will be required to ensure FSTDs are properly evaluated in order to fully implement the flight training required in the Crewmember and Aircraft Dispatcher Training Final Rule.

In the Crewmember and Aircraft Dispatcher Training Final Rule, the FAA established a 5-year compliance period for air carriers to update their training programs because of the need to revise both the FSTD standards and to allow for FSTD sponsors to have a sufficient amount of time to make any required modifications to their FSTDs as a result of this rulemaking. The FAA recognizes that a significant amount of engineering, testing, and subject matter expert evaluation time will be required to evaluate and modify the numerous FSTDs that will be required to conduct such tasks in part 121 training programs. As a result, the FAA has proposed a 3-year compliance period in the FSTD Directive that would require the evaluation and modification of previously qualified FSTDs that will be used for certain ''extended envelope'' and other training tasks in the Crewmember and Aircraft Dispatcher Training Final Rule. The FAA believes that the 5-year compliance period in the Crewmember and Aircraft Dispatcher Training Final Rule provides sufficient time to complete this rulemaking and also to give FSTD sponsors enough time to comply with the proposed 3-year compliance period in the FSTD Directive. While the FAA recognizes that some sponsors and operators may already have the technology and simulation knowledge necessary to make the changes proposed in the FSTD Directive, we recognize that there is a significant variation in the capability of previously qualified FSTDs as well as the technical expertise available to FSTD sponsors which could require more or less compliance time than what the FAA has anticipated. We request comment on whether the 3-year compliance period in the FSTD Directive is adequate, too short, or too long. The comments should also take into consideration the March 2019 compliance date for the new training task requirements in the Crewmember and Aircraft Dispatcher Training Final Rule and indicate whether that time is adequate, too short, or too long.

5. Stick Pusher and Adverse Weather Event Training Aviation Rulemaking Committee

The formation of the SPAW ARC was mandated by Public Law 111–216, Section 208. It held its first meeting on November 30, 2010, and held its last full group meeting on May 12, 2011. The SPAW ARC included members from aircraft manufacturers, simulator manufacturers, training companies, pilot associations, and airlines.

The final report provided numerous recommendations to the FAA on stall and stick pusher training, upset recovery training, icing training, and microburst and windshear training. In addition to the training recommendations, the ARC made recommendations to the FAA in its final report concerning the potential lack of simulator fidelity and proposed modifications to part 60 to address those deficiencies. The ARC cited several specific areas of improvement to simulation including modeling of flight dynamics and performance changes due to ice accretion, modeling of aircraft response in a stall, and providing flight instructors with improved feedback concerning the validity of the simulation during upset prevention and recovery training maneuvers. A copy of the SPAW ARC's final report has been placed in the docket for this rulemaking.

6. Advisory Circular (AC) 120–109 (Stall and Stick Pusher Training)

In August 2012, the FAA issued AC 120–109 (Stall and Stick Pusher

Training),[3] which provided a series of best practices relating to training, testing, and checking of stall warnings; aerodynamic stalls and stick pusher activations; and recommended recovery procedures. The content of this AC was developed using the recommendations of previous working groups and was intended to provide guidance to training providers and air carriers to ensure correct and consistent responses to unexpected stall warnings and stick pusher activations.

7. Loss of Control Avoidance and Recovery Training (LOCART) Working Group

In March 2012, the FAA reconvened the SPAW ARC to seek more detailed recommendations on academic and flight training programs to support the upset prevention and recovery training that was proposed by the SNPRM on air carrier crewmember training. The ARC was also tasked with examining the training device requirements to support upset prevention and recovery training in an FSTD. The final report from this ARC included technical recommendations to revise the part 60 FSTD standards to include minimum FSTD evaluation requirements for upset prevention and recovery training maneuvers. Some of these recommendations to amend part 60 expanded upon the previous recommendations made in the original SPAW ARC report. A copy of this final report has also been placed in the docket for this rulemaking.

C. Deficiencies in FSTD Evaluation Requirements

1. Full Stall Training Maneuvers

The SPAW ARC examined various issues involving stall training and recommended against any simulator training being conducted beyond the first indication of the stall unless the simulator modeling and fidelity are such that the simulation of the specific airplane is representative in this flight regime. Particular concerns addressed by the SPAW ARC regarding FSTD fidelity in full stall maneuvers were the modeling of aircraft stability and aircraft response to control inputs, improved motion response for acceleration cueing, and improved modeling of the stall buffet to cover a broader range of flight conditions. The SPAW ARC also made recommendations concerning the evaluation of FSTD stall characteristics in flight conditions other than wings-level stalls. These include stall training maneuvers such as high altitude cruise stall, turning flight (accelerated) stall, and the objective validation of stick pusher forces (where equipped in the aircraft).

The exposure of flightcrews to a low fidelity representation of an airplane's stall characteristics in an FSTD can lead to improper recovery techniques being reinforced during training. Such improper recovery techniques can be evidenced in the investigation of the 1996 Airborne Express DC–8 aircraft accident in Narrows, Virginia. In this investigation, the NTSB concluded that the flightcrew had been exposed to a low fidelity reproduction of the DC–8's stall characteristics in the company's flight simulator that likely contributed to their inappropriate response to an actual stall in the aircraft. The NTSB report stated:

The simulator's benign flight characteristics when flown more into the stall provided the flightcrew with a misleading expectation of the handling characteristics of the actual airplane. The [pilot flying (PF)] initial target pitch attitudes during the attempted stall recovery (from 10 degrees to 14 degrees) may have resulted in a successful recovery during his practice and teaching in the simulator. Further, because their experience with stalls in the DC–8 was obtained in a simulator without a stall break, the PF and [pilot not flying (PNF)] could not practice the nose-down control inputs required to recover a stalled airplane that is pitching down or at a nose-low attitude. Moreover, because the PF and PNF were exposed during extensive simulator experience to what they presumed was the stall behavior of the DC–8, the stall break that occurred in the airplane most likely surprised them. The Safety Board concludes that the flightcrew's exposure to a low fidelity reproduction of the DC–8's stall characteristics in the ABX DC–8 flight training simulator was a factor in the PF holding aft (stall-inducing) control column inputs when the airplane began to pitch down and roll, which contributed to the accident.[4]

The FAA notes that because there has never been a requirement for an air carrier to conduct training in a simulator to a full stall,[5] there has been relatively little exposure of flightcrews to such low fidelity stall characteristics in a simulator. However, once full stall training becomes a mandatory training requirement for air carriers, it is imperative that any FSTD being used to conduct such training is properly evaluated to ensure such negative training does not take place as evidenced in the Airborne Express accident. Failing to properly evaluate air carrier FSTDs to deliver this training would potentially expose many crewmembers to incorrect stall characteristics in an FSTD and thereby introducing an associated safety risk.

2. Upset Recognition and Recovery Training Maneuvers

The SPAW ARC recommended that simulator and academic training in upset prevention and recovery should be based on the Airplane Upset Recovery Training Aid (AURTA).[6] The SPAW ARC further stated that instructors do not always have the proper tools to provide adequate feedback to students with respect to control responses and aircraft operating limits during upset prevention and recovery training. Additionally, they noted if part of the training is conducted outside of the simulator's validated envelope,[7] there is an increased risk that the simulator will no longer accurately replicate the aircraft, which could result in negative training. The SPAW ARC recommended improved instructor feedback tools which can display when a training pilot has exceeded either the accepted simulator model envelope or the known aircraft load factor envelope. These instructor feedback tools would allow the instructor to identify and inform the student that he or she is exceeding those limits, thus mitigating potentially negative training. Furthermore, the SPAW ARC recommended employing the AURTA methods in assessing an FSTD's capability to conduct such maneuvers and to provide improved instructor feedback mechanisms to better evaluate both the FSTD's and the student's performance during such training.

When an FSTD is used to conduct upset recovery training, the instructor must be provided with the necessary tools to assess a student's performance when executing the recovery. When an instructor does not have these tools, potentially dangerous or inappropriate control strategies may be learned in the

[3] FAA Advisory Circulars can be located on the FAA's public internet site at: *http://www.airweb.faa.gov/*.

[4] See NTSB aircraft accident report number NTSB/AAR–97/05: Uncontrolled Flight into Terrain; ABX Air (Airborne Express); Douglas DC–8–63, N827AX; Narrows, Virginia (Dec. 22, 1996).

[5] Air carrier flight training is currently only required to train to an ''approach to stall'' flight condition where recovery is initiated at the activation of the stall warning system.

[6] The Airplane Upset Recovery Training Aid can be located on the FAA's public Internet site at: *http://www.faa.gov/other_visit/aviation_industry/airline_operators/training/*.

[7] An FSTD's validation envelope generally consists of those combinations of angle of attack and sideslip where the FSTD's aerodynamic model has been validated using flight test data or reliable predictive methods.

FSTD. In the case of the 2001 American Airlines flight 587 accident, the NTSB determined that an unrealistic portrayal of the aircraft's response to a wake vortex incident in the simulator may have contributed to the flying pilot applying unnecessary and excessive control inputs that ultimately led to the structural failure of the aircraft. Among the deficiencies the NTSB noted in the American Airlines Advanced Aircraft Maneuvering Program, the following were directly related to simulator functionality with regard to training upset recovery maneuvers to flightcrew members: [8]

- This simulator exercise could have caused the first officer of the accident flight to have an ''unrealistic and exaggerated view of the effects of wake turbulence; erroneously associate wake turbulence encounters with the need for aggressive roll upset recovery techniques; and develop control strategies that would produce a much different, and potentially surprising and confusing response if performed during flight.''
- The simulator exercise provided ''unrealistic portrayals of the airplane response to wake turbulence and significantly suppressed control input effectiveness to induce a large rolling potential that was unlikely to occur with an airplane as large as an A300–600.''
- The simulator exercise ''encouraged the use of rudder in a highly dynamic situation without portraying the large buildup in sideslip angle and side load that would accompany such rudder inputs in an actual airplane.''

Because the current FSTD evaluation standards do not contain minimum requirements on the implementation of aircraft upset scenarios, the potential remains for training to occur using such unrealistic upset scenarios. Furthermore, with improved instructor situational awareness available in the simulator (including improved feedback on student flight control inputs and simulator/aircraft operational limitations), it is possible that such aggressive roll upset recovery techniques as evidenced in the American 587 accident may have been identified and corrected during simulator training.

3. Airborne Icing Training Maneuvers

Although the simulation of engine and airframe icing has been an evaluation requirement for all Level C and Level D FSTDs since the early 1980's, the SPAW ARC recommended improving the fidelity of the aerodynamic effects of aircraft icing conditions in FSTDs used in flightcrew member training. The SPAW ARC stated specific aircraft data should be used when available; lacking that, other sources of engineering data may be used. The SPAW ARC further cited specific simulator improvements that the FAA should consider in developing improved standards for ice accretion models, such as the aerodynamic effects of lift, drag, and rotational moments (e.g. pitch, roll, and yaw effects) through means other than weight; the effects of icing on control feel, airframe buffeting, and control effectiveness; the potential to have the aircraft stall before the stall warning systems activate; the simulation of ice protection equipment failures; and the effect on engine performance due to ice ingestion.

Some current FSTD icing models simply employ a weight additive to the aircraft's gross weight in order to simulate more sluggish handling characteristics and higher stall speeds than expected. Although these characteristics may be representative of some effects of icing, the FAA believes the improved icing models that have been proposed would have an appreciable benefit to flightcrew training. FSTD icing models that incorporate the aerodynamic effects of ice accretion on lifting surfaces can provide critical recognition cues of dangerous ice buildup, such as changes in pitching moment, control effectiveness, and buffet characteristics. Furthermore, ice accretion on wing surfaces can disrupt the airflow over a wing, significantly in some cases, leading to an aerodynamic stall. Aerodynamic stall as a result of icing can occur at angles of attack much lower than stall warning systems are designed to activate. The ability to replicate these conditions in a simulator can provide invaluable training to flightcrews on the hazards of wing ice accretion and provide a higher awareness of the potential effects of icing conditions.[9] These proposed improvements would enhance the anti-icing training tasks that are currently required for air carrier training programs.

4. Microburst and Windshear Recovery Maneuvers

While accidents involving windshear and microburst have decreased significantly since the late 1980's, the SPAW ARC recommended improving FSTD evaluation requirements to support the standardization and quality of current training practices. Specific recommendations made by the SPAW ARC to improve FSTD functionality for windshear training included the addition of ''complex'' windshear models (as defined in the Windshear Training Aid) to provide flightcrew members experience in more realistic windshear encounters; employing methods to ensure an FSTD is properly configured for a windshear training profile; and including realistic levels of turbulence with existing windshear profiles.

5. Takeoff and Landing in Gusting Crosswinds

The Crewmember and Aircraft Dispatcher Training Final Rule introduced a new requirement to address an NTSB safety recommendation for the incorporation of ''realistic, gusty crosswind profiles'' into pilot simulator training programs. This recommendation was based on the results of an aircraft accident investigation in which the NTSB determined that a contributing factor of the accident was ''inadequate crosswind training in the airline industry due to deficient simulator wind gust modeling'' (see NTSB report AAR–10/04). During the course of the accident investigation, NTSB found that the airline's simulator did not have the capability to incorporate such realistic gusting crosswind scenarios for use in pilot training. Furthermore, the FAA reviewed the current part 60 FSTD evaluation standards and found that no such minimum requirement exists for the qualification of an FSTD for use in training.

6. Bounced Landing Training Maneuvers

The Crewmember and Aircraft Dispatcher Training Final Rule introduced a new requirement for bounced landing recovery training based on a review of accidents and various NTSB safety recommendations. As a result of public comments received in response to the Crewmember and Aircraft Dispatcher Training SNPRM, the FAA reviewed the part 60 minimum FSTD evaluation requirements to ensure that bounced landing maneuvers are adequately evaluated for crew training. The FAA notes that bounced landing

[8] See NTSB aircraft accident report number NTSB/AAR–04/04: In-Flight Separation of Vertical Stabilizer; American Airlines Flight 587; Airbus Industrie A–300–605R, N14053; Belle Harbor, New York; November 12, 2001.

[9] See NTSB aircraft accident report number NTSB/AAR–96/01: In-Flight Icing Encounter and Loss of Control; Simmons Airlines, d.b.a. American Eagle Flight 4184; Avions de Transport Regional (ATR) Model 72–121, N401AM; Roselawn, Indiana (Oct. 31, 1994).

maneuvers are not specifically included in the current part 60 technical evaluation requirements and, as a result, FSTDs used for this training may not have the required fidelity to properly conduct the training.

D. Related Actions

As a result of information gathered from various working groups, the FAA has taken action on loss of control training and simulator fidelity deficiencies by issuing the following voluntary guidance material:

- FAA Safety Alert for Operators (SAFO 10012)—Possible Misinterpretation of the Practical Test Standards (PTS) Language ''Minimal Loss of Altitude.'' The purpose of this alert bulletin is to clarify the meaning of the approach to stall evaluation criteria as it related to ''minimal loss of altitude'' in the Airline Transport Pilot PTS.
- FAA Information for Operators Bulletin (InFO 10010)—Enhanced Upset Recovery Training. This information bulletin recommends the incorporation of the material in the AURTA into flightcrew training. The AURTA contains guidance for upset recovery training programs for air carrier flightcrews as well as the evaluation guidance for FSTDs used in such training.
- FAA National Simulator Program (NSP) Guidance Bulletin #11–04—FSTD Modeling and Evaluation Recommendations for Engine and Airframe Icing
- FAA National Simulator Program (NSP) Guidance Bulletin #11–05—FSTD Evaluation Recommendations for Upset Recovery Training Maneuvers
- AC 120–109—Stall and Stick Pusher Training
- Airline Transport Pilot Practical Test Standards (Change 4).

Portions of this guidance material provide FSTD operators with recommended evaluation methods to improve FSTD fidelity for selected training tasks. To ensure that all FSTDs used to conduct such training are evaluated and modified to a consistent standard, the applicable part 60 technical requirements must be modified.

E. National Transportation Safety Board (NTSB) Recommendations

This proposal would incorporate changes into part 60 that would either directly or indirectly address the following NTSB Safety Recommendations through improved FSTD evaluation standards to support the outlined training tasks:

- Stall training and/or stick pusher training (Recommendations A–10–22, A–10–23, A–97–47, A–07–03, and A–10–24)
- Upset Recognition and recovery training (Recommendations A–042–62 and A–96–120)
- Engine and airframe icing training (Recommendations A–11–46 and A–11–47)
- Takeoff and landing training in gusting crosswind conditions (Recommendations A–10–110 and A–10–111)
- Bounced landing training (Recommendations A–00–93 and A–11–69).

III. Discussion of the Proposal

A. The FSTD Evaluation Process

For a new FSTD to be used in an FAA approved training program, it must be evaluated in accordance with the technical standards defined in the Qualification Performance Standards (QPS) appendices in part 60 and issued a Statement of Qualification. The QPS appendices in part 60 consist of general requirements, objective testing requirements, and subjective testing requirements that the FSTD must be evaluated against for qualification at a specific level. To validate an FSTD's aerodynamic and ground model programming, objective tests are required that compare the FSTD's performance and handling qualities against flight-test-collected validation data within prescribed tolerances. These objective tests that are required for the qualification of an FSTD are defined in the part 60 QPS appendices. Although part 60 prescribes a minimum number of objective tests required for qualification, FSTD manufacturers and aerodynamic data providers often independently conduct additional tests to fully assess the FSTD's performance beyond the minimum requirements. This additional testing may consist of supplemental validation using flight test data, engineering simulation data, or wind tunnel analysis to expand the validation envelope of an FSTD.

While objective testing using flight test data is generally the preferred method for FSTD validation, many flight training maneuvers cannot be practically validated in such a manner due either to the wide variance that arises in the flight test response due to unsteady aerodynamics and airplane stability, or to the safety risk associated with the flight data collection. These maneuvers include flight at angles of attack beyond stall identification, flight characteristics associated with significant icing, or other maneuvers where significant safety risks exist in the collection of flight test data. For such maneuvers, reliance on engineering and analytical data to extend an FSTD's validation envelope may be both appropriate and acceptable where the flight training objectives can be accomplished.

B. General Rationale for the Proposal

The primary objective of this NPRM is to introduce FSTD technical standards that adequately evaluate an FSTD's ability to replicate the performance and flight handling characteristics of an aircraft during specific new and revised training tasks required as part of an air carrier training program. For many of these new training requirements, the current part 60 and previously grandfathered FSTD evaluation standards do not adequately assess an FSTD's fidelity beyond the normal flight envelope. New FSTD evaluation standards therefore must be developed prior to requiring these enhanced training tasks. An accurate and realistic training environment is necessary to ensure flightcrew members are properly trained in the recognition of a dangerous onset of an upset or a stall condition as well as being able to properly react if the recognition cues are missed. Accident history has shown that unrealistic recognition cues and recovery techniques learned in an FSTD can contribute to an improper recovery technique being attempted in the aircraft.

A secondary objective of this NPRM is to promote harmonization with the current international FSTD qualification guidance to the maximum extent possible. To meet this objective, the FAA is proposing to adopt portions of the ICAO 9625, Edition 3 FSTD evaluation guidance into the appropriate part 60 QPS appendices. This would be limited to revising the part 60 Appendix A standards for Level C and Level D FSTDs with the updated guidelines in ICAO 9625 for a Type VII device. It would also introduce a new FTD level in Appendix B of part 60 using the ICAO 9625 guidelines for a Type V device.

The part 60 technical standards for the evaluation of an FSTD are contained in the QPS appendices of the rule. These QPS appendices are further subdivided into various attachments and tables containing General Simulator Requirements, Objective Testing Requirements, and Subjective Testing Requirements. Due to the extensive reorganization required to align the tables within the part 60 QPS appendices to match the ICAO 9625, Edition 3 structure and numbering

format, the FAA is proposing to reissue both appendix A and appendix B in their entirety. All significant amendments are discussed in the following sections as they relate to the intended objectives.

Under this proposal, the changes to the technical evaluation standards in the QPS appendices would become effective for all FSTDs that are newly qualified or upgraded in qualification level 30 days after publication of a final rule implementing these provisions. However, FSTD sponsors may elect to use the existing part 60 standards to qualify new or upgraded FSTDs for up to 24 months after the effective date of a final rule under the grace period provisions that are currently defined in § 60.15(c). All FSTDs (including previously qualified or grandfathered FSTDs) that would be used conduct certain extended envelope and other training tasks required by the Crewmember and Aircraft Dispatcher Training Final Rule would require evaluation within three years of the effective date of a final rule in accordance with the proposed FSTD Directive. See section III.C. for additional information on the proposed FSTD Directive.

C. Requirements Applicable to Previously Qualified FSTDs—FSTD Directive 2 (Appendix A, Attachment 6)

Previously qualified FSTDs retain ''grandfather rights'' in accordance with the current part 60 rule.[10] As a result, most changes made to the part 60 QPS appendices would not be applicable to previously qualified FSTDs. Because the majority of FSTDs that would be used to conduct the training required by the Crewmember and Dispatcher Training Final Rule would retain grandfather rights and would not require requalification under the new standards, the FAA must issue an FSTD Directive to ensure these previously qualified FSTDs are properly evaluated. The primary purpose of this proposal is to address the potential lack of FSTD fidelity in certain individually identified training tasks that will be required for air carrier training when the Crewmember and Aircraft Dispatcher Training Final Rule becomes effective.

An FSTD Directive is defined in § 60.23 for existing FSTDs and provides the FAA with a mechanism to mandate FSTD modifications where necessary for safety of flight reasons. Some of the training tasks that have been mandated by Public Law 111–216 and required in the Crewmember and Aircraft Dispatcher Training Final Rule have significant potential to introduce either inappropriate or incomplete training to flightcrew members due to a lack of FSTD fidelity. In most of these training tasks, the flight conditions the crews would be exposed to have never been previously experienced in the aircraft, making the accuracy and realism of the FSTD of prime importance. The potential of inadequate fidelity of an FSTD used to conduct such training can lead to a misunderstanding of recognition cues, learning of inappropriate recovery techniques, and an unrealistic understanding, or a lack of understanding of dangerous flight conditions that must be avoided. As a result, the FAA believes that proper evaluation of any FSTD (including those previously qualified FSTDs that hold grandfather rights) used to conduct these training tasks must be accomplished. To keep the cost of evaluating and modifying previously qualified FSTDs to a minimum, the FAA is proposing to apply the requirements of the FSTD Directive only to those FSTDs that would be used to accomplish specific training tasks as described in the FSTD Directive. Under this proposal, FSTD Sponsors may choose to qualify any number of FSTDs to conduct any of the individual tasks as required to meet the needs of their training programs. FSTDs that have been evaluated and modified in accordance with the FSTD Directive would have their Statements of Qualification modified to indicate the FSTD has been evaluated and qualified for the tasks.

The QPS requirements for the qualification of full stall maneuvers and upset recognition and recovery maneuvers are generally applicably to Level C and Level D FSTDs that have minimum requirements for both six degree of freedom motions cues and motion special effects (stall buffet) cues. Particularly for full stall maneuvers that involve significant roll and yaw deviations as well as high bank angle upset recovery maneuvers, motion cues in all six degrees of freedom are critical to provide the pilot with the cues necessary to learn effective recovery techniques. Additionally, motion vibration (buffet) cueing is necessary for the qualification of full stall maneuvers in order to provide the pilot with the proper recognition cues of an impending stall.

The FAA recognizes that some of the full stall and upset recognition and recovery maneuvers described in this proposal may not necessarily result in significant roll or yaw deviations (such as wings level stalls and nose high/nose low upsets with no bank angle) and could potentially be conducted in a Level A or a Level B FFS equipped with a three degree of freedom motion cueing system.[11] Furthermore, many Level A FFSs that do not have a minimum requirement for the simulation of stall buffets may, in fact, be equipped with such a system on a voluntary basis.[12] It is for these reasons, the FAA has proposed that Level A and Level B FFSs may be considered for the qualification of certain full stall and upset recognition and recovery maneuvers in accordance with the FSTD Directive where the motion and vibration cueing systems have been specifically evaluated to provide adequate cues for the accomplishment of the particular training tasks. Specific full stall or upset recovery maneuvers (such as high bank angle upset recovery maneuvers) may be excluded from qualification where it has been determined that the FSTD cannot provide the proper motion or vibration cues to accomplish the particular training tasks.

The FAA has considered the potential cost impact of imposing new evaluation requirements on previously qualified FSTDs where aerodynamic data and associated validation data for objective testing may not exist. Particularly with older aircraft and FSTDs that have been out of production for a number of years or may no longer be supported by the original aerodynamic data provider, the FAA recognizes that the collection of such data may prove to be very costly. In order to mitigate this potential cost impact, the FAA has proposed a number of cost relieving provisions in the FSTD Directive that would reduce the overall cost of compliance with the Directive. These provisions include:

- All new objective test cases for stall maneuvers include those maneuvers that are typically required for aircraft certification, such as turning flight stall and cruise configuration stalls. This would increase the likelihood that the aircraft manufacturer may already have flight test validation data on hand for use in validating required objective tests.

- Where an FSTD's aerodynamic data package is supplied by an aircraft manufacturer, the FAA is proposing to allow the use of approved engineering simulation data[13] for the purposes of

[10] See § 60.17, Previously Qualified FSTDs.

[11] Level A and Level B FFSs have minimum requirements for three degrees of freedom motion cues. See 14 CFR Part 60, Table A1A, Section 5.b.

[12] Level A FFSs do not have a minimum requirement for motion effects (stall buffets). See 14 CFR Part 60, Table A1A, Section 5.e.

[13] 14 CFR part 60, Appendix A, Attachment 2, paragraph 9.

meeting the objective testing requirements of the FSTD Directive.

• Where no adequate flight test data or engineering simulation data is available for use in validating required objective tests for stall maneuvers, the FAA is proposing to allow the validation of objective tests through evaluation by a subject matter expert pilot with relevant experience in the aircraft.

• For evaluating full stall maneuvers, where aerodynamic modeling data or validation data is not available or insufficient to fully meet the requirements of the Directive, the National Simulator Program Manager (NSPM) may restrict FSTD qualification to certain maneuvers where adequate validation data exists. For example, if validation data exists only for wings level stall maneuvers at angles of attack at or below the stick pusher activation, the NSPM may still qualify the FSTD for those limited stall maneuvers where data exists (in this example, wings level stalls where recovery is initiated at stick pusher activation).

The primary focus of this FSTD Directive is for those FSTDs that would be used to meet the air carrier training requirements in the Crewmember and Aircraft Dispatcher Training Final Rule. However, because the same safety risk exists for inappropriate simulator training in non-air carrier training programs, other qualified FSTDs that would be used to conduct such training tasks in any FAA-approved flight training program would also have to meet the requirements of this FSTD Directive. Since existing air carriers would not have to comply with the mandatory training requirements until 5 years after the Crewmember and Aircraft Dispatcher Training rulemaking becomes effective, the FAA believes there is sufficient time for the affected previously qualified FSTDs to be evaluated and modified in accordance with the FSTD Directive before such training takes place. In cases where affected training tasks are currently being conducted on a voluntary basis and the FSTD has been evaluated by the sponsor to conduct such maneuvers, the FAA has no intent to immediately halt such training. In order for such FSTDs to be modified and evaluated in a timely manner as described in the Directive, the FAA is proposing a compliance date of 3 years after this rule (and associated FSTD Directive) becomes effective. After that date, any FSTD being used in an FAA-approved training program for the following training tasks must be evaluated and issued an amended Statement of Qualification (SOQ) by the NSP in accordance with the FSTD Directive:

▪ Stall training maneuvers that are conducted at angles of attack higher than the activation of the stall warning system. This does not include approach-to-stall (stall prevention) maneuvers where recovery is initiated at the activation of the stall warning system.

▪ Upset Recognition and Recovery training maneuvers.

▪ Engine and Airframe Icing training maneuvers that demonstrate the aircraft specific effects of engine and airframe ice accretion.

▪ Takeoff and landing training tasks with gusting crosswinds.

▪ Bounced landing recovery training tasks.

Specific evaluation requirements that have been proposed for previously qualified FSTDs by FSTD Directive are indicated in the following sections by topic (sections D through H).

D. FSTD Evaluation Requirements for Full Stall Training Tasks (Appendix A; Table A1A, Section 2.1.7.S, Table A2A, Tests 2.a.10, 2.c.8, and 3.f.8; Table A3A, Test 5.b.1; and Attachment 7)

The current and previous FSTD qualification standards (dating back to AC 121–14C in 1980) contain both objective and subjective testing requirements for full stall maneuver evaluation. While these requirements include the evaluation of full stall maneuvers, the objective testing requirements are limited to only validating stall warning speeds, stall buffet onset speeds, and the stall speeds in flight conditions typically used for aircraft certification testing in a very controlled environment (such as wings level stalls in approach and climb configurations). Because there has never previously been a requirement to conduct full stall training in an FSTD (historically, stall training ends at the first indication of the stall), relatively little emphasis has been placed on the objective validation of simulator performance and handling qualities at airspeeds lower than the activation of the stall warning system.

When flight training to a full stall is provided to crewmembers, recognition cues and performance and handling characteristics in the FSTD must be accurate to ensure pilots properly respond to stall events or low energy states. Where a stall is imminent, critical seconds can be lost if the crew is not aware of the low energy cues indicating that the aircraft is approaching a dangerous flight condition. Furthermore, if a stalled condition is encountered in flight, accurate and repeated training helps pilots react and apply appropriate control input(s), to maintain or regain the desired flight path. Training in accurate and realistic scenarios may also help mitigate the startle factor that often accompanies such an event.

While the existing FSTD stall evaluation requirements have generally proven to be sufficient for approach to stall training tasks that terminate at the first indication of the stall, these standards do not adequately extend beyond the activation of the stall warning system for the purpose of validating the FSTD's performance and handling qualities at the stall through recovery. New FSTD evaluation requirements for stall recognition and aircraft handling qualities are necessary if training is to be conducted to a full stall. Most aerodynamic modeling on modern FSTDs assumes a certain amount of linearity from objectively validated test points to extrapolate aircraft performance and handling qualities between test points. As an aircraft approaches a stalled flight condition, this linearity can no longer be assumed, and more test points are required to validate the fidelity of the model.

Through the work of ICATEE and the SPAW ARC, several subject matter experts on pilot training concluded that stall recovery training does not require, nor is it practical, that the post stall behavior of the aircraft be exactly replicated in the FSTD. They also concluded that a ''type representative'' post stall model should suffice in properly training the recovery maneuver. Because of the typically unstable behavior of the aircraft at or beyond the stall angle of attack, it is not reasonable or practical to require tight tolerances applied to objective tests against flight test validation data beyond the stall angle of attack. In lieu of mandating objective tolerances in the post stall flight regime, it was recommended that the use of analytical methods, engineering simulation, and wind tunnel methods in combination with subject matter expert pilot assessment be authorized to develop and validate ''type representative'' post stall models.

In consideration of the recommendations of the SPAW ARC, the FAA proposes to amend the appendix A QPS requirements to improve the FSTD evaluation requirements for full stall training tasks. These amendments are intended to accomplish the following objectives to improve FSTD fidelity for flightcrews conducting full stall training tasks:

• Improve the fidelity of the FSTD's aerodynamic model and cueing systems

at angles of attack beyond the first indication of the stall (stall warning, stick shaker, etc.) to better match the aircraft specific recognition cues of an impending stall. This is accomplished through:

○ Improved objective testing to include additional test cases against approved validation data (flight test data, engineering simulation data, etc.) in training critical maneuvers such as turning flight (accelerated) stalls, high altitude (clean configuration) stalls, power-on stalls, and stalls at multiple flap settings.

○ New and improved objective testing tolerances to better validate performance and handling qualities, control inputs, stall buffet, and stick pusher forces (if equipped) of the FSTD as the stall is approached.

• Improve the fidelity of the FSTD's aerodynamic model and cueing systems at the stall break (if present) through stall recovery. This is accomplished through:

○ Defining a minimum level of fidelity and modeling requirements to develop ''type representative'' extended full stall models using available flight test data and alternate methods, such as engineering simulation, analytical methods, and wind tunnel analysis.

○ Defining functional evaluation criteria for qualified subject matter expert evaluation to determine suitability of a representative full stall model that supports training requirements.

In order to accomplish these objectives to improve FSTD fidelity in full stall training maneuvers, the FAA is proposing revisions to the following sections in appendix A of the QPS for FFSs. Where a specific requirement has been proposed for previously qualified FSTDs by FSTD Directive, it is indicated as such with an ''FD'':

Table A1A (General Simulator Requirements)

• Section 2.1.7.S/[FD] (High Angle of Attack Modeling)

Table A1B (Table of Tasks vs. Simulator Level)

• Table A1B, Section 3.b. (High Angle of Attack Maneuvers)

Table A2A (Full Flight Simulator Objective Tests)

• Test 2.a.10/[FD] (Stick Pusher System Force Calibration)
• Tests 2.c.8.a. and 2.c.8.b/[FD] (Stall Characteristics)
• Test 2.f.8. (Characteristic Motion Vibrations—Buffet at Stall)

Table A3A (Functions and Subjective Tests)

• Tests 5.b.1.a and 5.b.1.b/[FD] (Maneuvers—High Angle of Attack)

Attachment 7 (Additional Simulator Qualification Requirements for Stall, Upset Recognition and Recovery, and Airborne Icing Training Tasks)

• High Angle of Attack Model Evaluation [FD]

E. FSTD Evaluation Requirements for Upset Recognition and Recovery Training Tasks (Appendix A; Table A1A, Section 2.1.6.S and Attachment 7)

The current part 60 requirements do not explicitly define a minimum envelope of FSTD aerodynamic model validity required for training purposes. The objective validation of an FSTD is primarily based on direct comparison of the FSTD's performance and handling qualities against that of flight test collected validation data in a representative cross section of the flight envelope that includes many relevant training maneuvers. Outside of these objectively validated test conditions, an FSTD's aerodynamics are typically interpolated or extrapolated using predictive methods and data sources such as wind tunnel data and analytically derived data. Many of the recommended upset recovery training maneuvers (as defined in the AURTA) are conducted in flight regimes that make direct comparison against flight test data impractical due to safety concerns. However, since much of the aerodynamic characteristics necessary to program an FSTD to conduct such maneuvers are based on angle of attack and sideslip ranges that can be derived from flight testing and reliable predictive methods, a certain amount of aerodynamic model fidelity can be accurately implied across a large range of pitch, roll, and heading values. This aerodynamic model fidelity would necessarily be a function of the quality and amount of data sources, ranging from flight test and wind tunnel data sources through established extrapolation methods.

In addition to defining and measuring aerodynamic model fidelity in upset recovery maneuvers, it is important that the instructor have real-time situational awareness with respect to the aircraft's operational limits (including the degree to which the simulation being used accurately portrays the actual reaction of the airplane) and the flight control inputs being used by the student to conduct the recovery. It is critical for the instructor to be able to assess the student's application of control inputs, including those that may not be readily visible from the instructor's station (such as rudder pedal displacements and forces) to ascertain that control inputs to affect recovery do not result in exceeding either the aircraft's operational load limits or the simulator's validation data limits.

In order to properly conduct upset recovery training in an FSTD, a feedback mechanism is necessary to provide full situational awareness to the instructor to properly assess the student's recovery technique. The FAA proposes new requirements to define minimum requirements for a feedback mechanism necessary for upset recovery training in an FSTD. However, because FSTD sponsors may choose a number of methods to accomplish this, the FAA has not prescribed the exact content and layout of such a feedback mechanism. In this proposal, the FAA has included examples of recommended Instructor Operating Station displays the information section of appendix A.

In order to codify all of the proposed qualification requirements for upset recovery training in an FSTD, the FAA is proposing the following changes to Table A1A (General Simulator Requirements) and Attachment 7 of appendix A:

• The FSTD's validation limits (as a function of angle of attack and sideslip angle) must be defined by the aerodynamic data provider for use in establishing a validation envelope of the FSTD for upset recovery training maneuvers.

• For airplane upset conditions or scenarios,[14] the FSTD's aerodynamics must be evaluated to ensure the FSTD can stay within the flight tested or wind tunnel validation envelope during the execution of the recovery maneuvers. A minimum of three defined maneuvers (consistent with the maneuvers described in the AURTA) must be evaluated for FSTD qualification.

• Externally driven dynamic upset scenarios must be realistic, based on relevant data sources, and must not artificially degrade the simulated aircraft's performance capability without clear indication to the instructor.

• An instructor feedback mechanism must be provided to notify the instructor where the FSTD's validation envelope or the aircraft's operating limits has been exceeded. This feedback mechanism must also provide the

[14] The AURTA generally defines an airplane upset as one of the following unintentional conditions: Pitch attitude greater than 25 degrees nose up; Pitch attitude greater than 10 degrees nose down; Bank angle greater than 45 degrees; or flying at airspeeds inappropriate for the conditions.

instructor with relevant flight control position information and have the ability to record and playback for debriefing purposes.

In order to accomplish these objectives to improve FSTD functionality for upset recognition and recovery maneuvers, the FAA is proposing revisions to the following sections in appendix A of the QPS for FFSs. Where a specific requirement has been proposed for previously qualified FSTDs by FSTD Directive, it is indicated as such with an ''FD'':

Table A1A (General Simulator Requirements)

- Section 2.1.6.S/[FD] (Upset Recognition and Recovery)

Table A1B (Table of Tasks vs. Simulator Level)

- Section 3.f. (Upset Recognition and Recovery)

Table A3A (Functions and Subjective Tests)

- Test 5.b.15/[FD] (Maneuvers—Upset Recognition and Recovery)

Attachment 7 (Additional Simulator Qualification Requirements for Stall, Upset Recognition and Recovery, and Airborne Icing Training Tasks)

- Upset Recognition and Recovery Evaluation [FD]

F. FSTD Evaluation Requirements for Airborne Icing Training Tasks (Appendix A; Table A1A, Section 2.1.5.S; Table A2A, Test 2.i. and Attachment 7)

The FAA is proposing to amend the evaluation requirements for the simulation of engine and airframe icing as currently required in part 60 for Level C and Level D FSTDs. The proposed changes would require that an FSTD have ice accretion models that simulate the aerodynamic effects of ice accretion on the lifting surfaces of the aircraft. These ice accretion models must be realistic and based upon relevant data sources, such as aircraft manufacturer's data or other acceptable analytical methods. The SPAW ARC recommendations form the basis for these proposed requirements. The SPAW ARC recommended that aircraft type-specific flight training be conducted on the aerodynamic effects of ice accumulation; the use and failure of aircraft ice equipment; the use of autopilot; and the performance and handling effects of ice accumulation. The SPAW ARC cites incidents in which aircraft have encountered stall warning, stall buffet, and aerodynamic stall at lower than normal angles of attack due to ice accretion. Accordingly, the SPAW ARC found it to be important that flightcrews are appropriately trained on this phenomenon in a simulator training scenario that emphasizes that in icing conditions, the stall warning or protection system may not activate and stall margins may be significantly reduced.

The SPAW ARC further noted that some simulators may lack the fidelity to accurately portray the aerodynamic effects of ice accumulation. While minimum requirements for engine and airframe icing have existed in the FSTD qualification standards since the early 1980's, these requirements have lacked the specific detail for aerodynamic effects to be simulated. On many older simulators, the effects of ice accumulation have been approximated by adding weight increments to the simulated aircraft. While some icing effects can be approximated using this method, many other critical icing characteristics are not realistically replicated in this manner. For example, neither the altered critical angle of attack due to ice accumulation nor the actual weight indicative of the accumulation are accurately replicated using such weight increments.

To improve flightcrew training for such events, the FAA is proposing to amend some of the current requirements for FSTD evaluation of engine and airframe icing. These amendments would enhance the existing flightcrew training requirement for anti-icing operations by improving the recognition cues and realistic aerodynamic effects of ice accretion. The changes are based on the updated engine and airframe icing requirements that are published in the ICAO 9625, Edition 3 international FSTD qualification guidance as well as the following additional improvements that were recommended by the SPAW ARC:

- Ice accretion models must incorporate the aerodynamic effects of icing (where appropriate for the aircraft) such as reduced stall angle of attack, loss of lift, changes in pitching moment, and control effectiveness. These models must be based on aircraft original equipment manufacturer data or other analytical methods.
- Aircraft systems, such as autoflight systems and stall protection systems must respond properly to the effects of ice accretion.
- Objective tests must be developed to demonstrate the intended aerodynamic effects of simulated ice accretion.

In order to accomplish these objectives to improve FSTD fidelity in airborne icing training maneuvers, the FAA is proposing specific revisions to the following sections in appendix A of the QPS for FFSs. Where a specific requirement has been proposed for previously qualified FSTDs by FSTD Directive, it is indicated as such with an ''FD'':

Table A1A (General Simulator Requirements)

- Section 2.1.5.S/[FD] (Engine and Airframe Icing)

Table A2A (Full Flight Simulator Objective Tests)

- Test 2.i (Engine and Airframe Icing Effects Demonstration)

Attachment 7 (Additional Simulator Qualification Requirements for Stall, Upset Recognition and Recovery, and Airborne Icing Training Tasks)

- Engine and Airframe Icing Evaluation [FD]

G. FSTD Evaluation Requirements for Takeoff and Landing Training Tasks in Gusting Crosswinds (Appendix A, Table A1A, Sections 3.1.S, 3.1.R, and 11.4.R)

The FAA has introduced new FSTD evaluation requirements for the modeling of gusting crosswinds for takeoff and landing training tasks. The basis for this change is due to a recent air carrier accident where the aircraft experienced strong and gusty crosswinds during takeoff roll and departed the runway. The NTSB concluded the following in their final accident report:

> Because Continental's simulator training did not replicate the ground-level disturbances and gusting crosswinds that often occur at or near the runway surface, and it is unlikely that the accident captain had previously encountered gusting surface crosswinds like those he encountered the night of the accident, the captain was not adequately prepared to respond to the changes in heading encountered during this takeoff.[15]

While the current part 60 requirements have both objective and subjective evaluation requirements for crosswind takeoff and landing maneuvers, there is no current requirement for the modeling of gusting crosswinds. Since steady state crosswinds are currently validated with objective testing, the FAA believes most FSTDs should have adequate aerodynamic and ground modeling to react properly when stimulated with gusting crosswind profiles. Furthermore, the FAA agrees with the

[15] Runway Side Excursion During Attempted Takeoff in Strong and Gusty Crosswind Conditions, Continental Flight 1404, December 20, 2008, NTSB Final Report, NTSB/AAR–10/04.

NTSB's recommendations that such gusting crosswind profiles should be realistic and based on data sources. However, the FAA believes that such realistic gusting crosswind profiles can be derived from existing sources, such as the FAA Windshear Training Aid, and evaluated for training by subject matter expert pilots.

To ensure the FSTD supports a realistic training environment, the FAA proposes to add the following minimum requirements for the modeling of gusting crosswind profiles and the evaluation of the ground handling characteristics of the FSTD:

- Realistic gusting crosswind profiles must be available to the instructor. The profiles must be tuned in intensity and variation to require pilot intervention to avoid runway departure during takeoff or landing roll.
- A Statement of Compliance would be required that describes the source data used to develop the crosswind profiles. Additional information material in the QPS appendix recommends the use of the FAA Windshear Training Aid or other acceptable data sources in determining appropriate wind profiles.
- The FSTD's ground reaction model must be subjectively assessed to ensure it reacts appropriately to the gusting crosswind profiles.

In order to accomplish these objectives to improve FSTD functionality for gusting crosswinds, the FAA is proposing revisions to the following sections in appendix A of the QPS for FFSs. Where a specific requirement has been proposed for previously qualified FSTDs by FSTD Directive, it is indicated as such with an ''FD'':

Table A1A (General Simulator Requirements)

- Section 3.1.S(2)/[FD] (Ground Handling Characteristics)
- Section 11.4.R/[FD] (Atmosphere and Weather—Instructor Controls)

Table A3A (Functions and Subjective Tests)

- Test 3.a.3/[FD] (Takeoff—Crosswind—maximum demonstrated and gusting crosswind)
- Test 8.d./[FD] (Approach and Landing with crosswind—maximum demonstrated and gusting crosswind)

H. FSTD Evaluation Requirements for Bounced Landing Training Tasks (Appendix A, Table A1A, Section 3.1.S)

The Crewmember and Aircraft Dispatcher Training SNPRM proposed new requirements for bounced landing training tasks to address various aircraft accidents and NTSB Safety Recommendations. In response to the SNPRM, the FAA received a comment from the Air Line Pilots Association International (Docket entry FAA–2008–0677–0307) with concerns about the ability of an FSTD to adequately represent a bounced landing.

The FAA reviewed the current FSTD qualification standards and found that many of the currently required objective tests do, in fact, test the fidelity on an FSTD in this phase of flight. Objective tests, such as the required minimum unstick speed takeoff test (Vmu), landing tests, and ground effect tests should provide for a reasonable validation of the FSTD's aerodynamic performance in this phase of flight. Furthermore, the current part 60 rule has explicit motion system effects requirements for tail and engine pod strikes that can typically be a result of an incorrectly performed touchdown that could lead to the necessity of a bounced landing recovery. However, it was noted that the current part 60 general requirements for ground reaction and ground handling did not address the effects that should be accounted for in the models. To address this deficiency, the FAA is proposing to add new general requirements for ground reaction modeling to ensure the effects of a bounced landing and related tail strike are properly modeled and evaluated. Because of the safety risk involved in collecting airplane flight test data for such a maneuver, no new objective testing would be required and only subjective assessment of the FSTD would be conducted for this particular task.

In order to accomplish these objectives to improve FSTD functionality for bounced landing training tasks, the FAA is proposing revisions to the following sections in appendix A of the QPS for FFSs. Where a specific requirement has been proposed for previously qualified FSTDs by FSTD Directive, it is indicated as such with an ''FD'':

Table A1A (General Simulator Requirements)

- Section 3.1.S(1)/[FD] (Ground Reaction Characteristics)

Table A3A (Functions and Subjective Tests)

- Test 9.3./[FD] (Missed Approach—Bounced landing)

I. FSTD Evaluation Requirements for Windshear Training Tasks (Appendix A, Table A1A, Section 11.2.R)

One of the mandates of Public Law 111–216 was for the FAA to form a multidisciplinary panel to study ''. . . methods to increase the familiarity of flightcrew members with, and improve the response of flightcrew members to, stick pusher systems, icing conditions, and microburst and windshear weather events.'' [16] The FAA chartered the SPAW ARC in response to this mandate. While the SPAW ARC agreed that microburst and windshear events have decreased significantly since the introduction of the Windshear Training Aid,[17] it recommended a number of improvements to enhance the current FSTD windshear qualification requirements. The FAA is proposing to adopt the following three recommendations of the SPAW ARC, which would improve on the realism and provide better standardization of windshear training events:

- All required windshear profiles must be selectable and clearly labeled on the FSTD's instructor operating station. A method must be employed (such as an FSTD preset) to ensure that the FSTD is properly configured for the selected windshear profile. This requirement is to ensure that the proper windshear cues are present in crew training as originally qualified on the FSTD.
- Realistic levels of turbulence associated with each windshear profile must be available and selectable to the instructor.
- In addition to the four basic windshear models that are currently required, two additional ''complex'' models would be required that represent the complexity of an actual windshear encounter. These additional models may be derived from the example complex models published in the Windshear Training Aid. This requirement would provide an opportunity for crew training and practice in responding to more challenging and realistic windshear events.

In order to accomplish these objectives to improve FSTD functionality for windshear training tasks, the FAA is proposing to revise the following section of appendix A in the QPS for FFSs. No retroactive requirements have been proposed for windshear qualification by FSTD Directive:

Table A1A (General Simulator Requirements)

- Section 11.2.R (Windshear Qualification)

[16] Public Law 111–216, Section 208(b).

[17] Windshear Training Aid, U.S. Department of Transportation, Federal Aviation Administration 1987.

J. Significant Changes To Align With the International FSTD Evaluation Guidance (Appendix A)

In addition to the part 60 changes to address extended envelope and adverse weather event training, the FAA is also proposing to incorporate select portions of the latest ICAO FSTD qualification guidance [18] into the part 60 QPS requirements where practical. ICAO 9625, Edition 3 represents a major industry effort that redefined all qualification levels of FSTDs to better align FSTD fidelity with the intended pilot training tasks. The FAA is not proposing to align with the entire ICAO 9625, Edition 3 guidance document because it contains FSTD levels that differ significantly from the FAA's existing hierarchy of FSTD levels. There are several device levels in the new ICAO guidance document that currently have no basis in the FAA's existing regulations or in the FAA's existing guidance on flight training. Because of the far reaching implications beyond part 60 if changes were made to the FAA's existing FSTD hierarchy, we have limited our alignment to those FSTDs and associated evaluation guidance in the ICAO 9625, Edition 3 document that have an equivalent device in the FAA (Level C and D) or could potentially be used in the future (Level 7 FTD) with minimal impact to the existing hierarchy. Incorporation of the other device levels and evaluation guidance would require careful consideration and additional rulemaking. The FAA notes that the primary purpose of this proposal is to address the weather event, stall, stick pusher, and upset recovery training tasks required by Public Law 111–216. The FAA will continue to assess the possibility of incorporating additional ICAO 9625, Edition 3 FSTD qualification levels and evaluation guidance; however any changes made in this proposal cannot jeopardize the timely implementation of updated FSTD standards to address new and revised training tasks mandated by Public Law.

After an assessment of the ICAO 9625, Edition 3 document, the FAA is proposing to make the following changes to appendix A (Qualification Performance Standards for Airplane Full Flight Simulators) to better align the evaluation standards for Level C and Level D FSTDs with that of the current international guidance. The FAA has not proposed to align the evaluation standards for Level A and Level B FSTDs because similar devices do not exist in the ICAO 9625, Edition 3 document. Additional changes to introduce a new FTD level as defined in ICAO 9625 have been proposed in appendix B (fixed wing Qualification Performance Standards for Airplane Flight Training Devices) and will be discussed in a later section.

In its review of the new ICAO 9625, Edition 3 guidance, the FAA finds that some of the guidelines necessary for inclusion into part 60 are more restrictive and may impose additional cost (such as the increased visual field of view requirements). However, a majority of the changes are less restrictive or reflect established FSTD evaluation practice. The proposed requirements in part 60 that would align with the new ICAO guidance are expected to reduce expenses and workload for FSTD Sponsors by avoiding conflicting compliance standards between the FAA and other Civil Aviation Authorities. These amendments incorporate technological advances in, encourage innovation of, and standardize the initial and continuing qualification requirements for FSTDs that are consistent with the guidance recently established by the international flight simulation community.

1. Table A1A (General Requirements): The FAA is proposing to rewrite table A1A to incorporate the ICAO 9625, Edition 3 language and numbering system where appropriate. The FAA changed the numbering system to use the ICAO 9625, Edition 3 fidelity definitions for each simulation feature and to incorporate all general requirements for the ICAO 9625, Edition 3 Type VII FSTD into the FAA Level C and Level D FSTDs where appropriate. The general requirements for Level A and Level B FSTDs have been left mostly unchanged to maintain continuity with the current hierarchy of FSTD qualification levels. Where such a fidelity level is not used for any part 60 defined FSTD, the FAA kept the numbering intact and marked it as ''reserved'' for future use. The following sections within Table A1A contain notable changes to align with the ICAO 9625, Edition 3 requirements:

- Section 1.1.S (Flight Deck Layout and Structure)—Introduces minimum requirements for electronically displayed representations of cockpit instrumentation. This amendment to the existing standard would give FSTD sponsors a lower cost option of simulating costly aircraft components with digital representations.
- Section 6.4.R (Sound Volume)—Requires indication to the instructor when FSTD sound volume is in an abnormal setting. This is a new standard though some FSTDs already have this functionality.
- Section 6.5.R (Sound Directionality)—Requires cockpit sounds to be directionally representative. This is a new standard, but generally reflects existing practice.
- Section 7.1.1.S (Visual System Field of View)—Increases minimum visual display system field of view requirements from 180 (horizontal) x 40 (vertical) degrees to 200 x 40 degrees.
- Section 7.1.6.S (Visual System Lightpoint Brightness)—Introduces a new minimum brightness requirement of 8.8 foot-lamberts for visual scene lightpoints.
- Section 7.1.8 (Visual System Black Level and Sequential Contrast)—Introduces a new maximum visual system black level and sequential brightness level requirements (applicable only to light valve projectors).
- Section 7.1.9 (Visual Motion Blur)—Introduces a new maximum visual system motion blurring requirements (applicable only to light valve projectors).
- Section 7.1.10 (Visual Speckle Test)—Introduces a new maximum visual system speckle contrast requirement (applicable only to laser projectors).
- Section 7.2.1 (Visual—Heads-Up Display)—Introduces new minimum general requirements for the simulation of heads-up display systems.
- Section 7.2.2 (Visual—EFVS)—Introduces new minimum general requirements for the simulation of enhanced flight vision systems.
- Section 13.8.S (Miscellaneous—Transport Delay)—Reduces the maximum transport delay requirements from 150 ms to 100 ms (more restrictive).

2. Table A2A (Objective Testing Requirements): The FAA is proposing to rewrite table A2A to incorporate all of the ICAO 9625, Edition 3 language and test tolerances. Most changes to this section are less restrictive as compared to the current part 60 standards. Less restrictive test tolerances or testing conditions are expected to reduce overall cost to an FSTD Sponsor due to a reduction in the engineering hours required to match objective test results to validation data. The FAA is proposing to change the tolerances and test conditions in the following tests to align with the ICAO 9625, Edition 3 objective testing requirements:

- Test 1.a.1 (Minimum Radius Turn)—Adds a new requirement for ''key engine parameters.''

[18] Manual of Criteria for the Qualification of Flight Simulation Training Devices, ICAO 9625, Edition 3, 2009.

- Test 1.b.1 (Ground Acceleration)—Revises the tolerance from ±5% of time to ±1.5 seconds or ±5% of time (less restrictive).
- Test 1.b.7 (Rejected Takeoff)—Adds an acceptable alternative to requiring maximum braking (80% of maximum braking).
- Test 1.d.1 (Level Acceleration)—Relaxes the speed change requirement from a minimum of 50 kts of speed increase to 80% of operational speed range (for airplanes with a small operating speed range).
- Test 1.d.2 (Level Deceleration)—Relaxes the speed change requirement from a minimum of 50 kts of speed increase to 80% of operational speed range (for airplanes with a small operating speed range).
- Test 1.e.1 (Deceleration Time and Distance)—Revises the tolerance from ±5% of time to ±1.5 seconds or ±5% of time (less restrictive).
- Test 1.e.2 (Deceleration Time and Distance, Reverse Thrust)—Revises the tolerance from ±5% of time to ±1.5 seconds or ±5% of time (less restrictive).
- Test 1.f.1 (Engine Acceleration)—Revises the total time of engine acceleration (Tt) from ±10% to ±10% or ±0.25 seconds (less restrictive).
- Test 1.f.2 (Engine Deceleration)—Revises the total time of engine deceleration (Tt) from ±10% to ±10% or ±0.25 seconds (less restrictive).
- Test 2.a.7 (Pitch Trim Rate)—Revises the tolerance on trim rate from ±10% to ±10% or ±0.1 deg/sec (less restrictive).
- Tests 2.b.1, 2.b.2, 2.b.3 (Dynamic Control Checks)—Places a minimum absolute (less restrictive) tolerance on both time (0.05 s) and amplitude (0.5% of total control travel) where minimum tolerances did not previously exist. This prevents the rigid application of very small tolerances (±10% of time and ±10% of amplitude) on certain flight control systems.
- Test 2.c.7 (Longitudinal Static Stability)—Adds a new test condition that ''the speed range should be sufficient to demonstrate stick force versus speed characteristics.''
- Test 2.e.3 (Crosswind Landing)—Adds a new test tolerance on column force for airplanes with reversible flight control systems. This additional tolerance will improve the overall validation of cockpit control forces during the landing maneuver. Previous standards only included control force tolerances for the wheel and rudder pedal inputs.
- Test 3.b. (Motion Leg Balance)—Removes the testing requirement for motion leg balance. This test was determined to have not provided additional value in assessing the capability of a motion cueing platform and was recommended for removal during the development of the ICAO 9625 document.
- Test 3.e.1 (Motion Cueing Fidelity)—Replaces the existing part 60 tests for ''motion cueing performance signature'' (MCPS) with an objective test for motion cueing developed by the ICAO 9625, Edition 3 International Working Group. This test is designed to better compare motion platform cueing with the actual translational and rotational motion experienced in the aircraft.
- Test 4.a.1 (Visual—Field of View)—Increases the minimum visual system field of view from 176 × 36 degrees to 200 × 40 degrees.
- Test 4.a.2.a (Visual—System Geometry)—Defines new system geometry tolerances for image position, absolute geometry, and relative geometry.
- Test 4.a.7 (Visual—Lightpoint Brightness)—Defines a new minimum lightpoint brightness tolerance
- Test 4.a.9 (Visual—Black Level)—Defines new maximum black level requirements
- Test 4.a.10 (Visual—Motion Blur)—Defines new tolerances for motion blur of visual scenes
- Test 4.a.11 (Visual—Laser Speckle)—Defines a new maximum laser speckle contrast tolerance for applicable display systems
- Tests 4.b.1, 4.b.2, 4.b.3 (Heads-Up Display)—Defines new minimum tolerances for HUD alignment, display, and attitude.
- Tests 4.c.1, 4.c.2, 4.c.3 (Enhanced Flight Vision Systems)—Defines new minimum tolerances for EFVS registration, RVR, and thermal crossover.
- Tests 5.a and 5.b. (Sound System)—Revised objective sound testing tolerances to address subjective tuning and repeatability for recurrent evaluations
- Tests 6.a.1 (Systems Integration—Transport Delay)—Transport delay tolerances are reduced from 150 ms to 100 ms.
- Paragraph 6.d. (Motion Cueing—Frequency Domain Testing)—Additional background and recommended testing procedures for the OMCT tests (replaces existing guidance on the MCPS tests).
- Paragraphs 11.a.1 and 11.b.5 (Validation Test Tolerances)—Extends reduced tolerances for engineering simulation validation data from 20% of flight test tolerances to 40% of flight test tolerances (less restrictive).

3. Table A3A (Functions and Subjective Testing Requirements): The FAA added is proposing to add subjective tests in the following sections to align with ICAO 9625, Edition 3:

- Test 2.b.6 and 2.b.7 (Taxi)
- Test 5.b.2 (Slow Flight)
- Tests 5.b.1 (High Angle of Attack)
- Test 5.b.13 (Gliding to a Forced Landing)
- Tests 5.b.14 (Visual Resolution and FSTD Handling and Performance)
- Tests 7.a.1, 10.a.1, 11.a.20 (HUD/EFVS)
- Tests 11.a.16, 11.a.20, 11.a.25, 11.a.26, 11.a.27 (New Technology)

4. Table A3B (Class I Airport Models)

- The FAA is proposing to restructure this table to align with the ICAO 9625, Edition 3 airport model requirements. No significant differences exist between this proposed table and the current part 60 requirements.

5. Table A3D (Motion System Effects): The FAA is proposing to add or modify tests in the following sections to align with ICAO 9625, Edition 3:

- Test 1 (Taxi)—Introduces a new requirement for lateral and directional motion cueing effects during taxi maneuvers.
- Test 2 (Runway Contamination)—Introduces a new requirement for motion effects due to runway contamination and associated anti-skid system characteristics.
- Test 7 (Buffet Due to Atmospheric Disturbance)—Introduces a new requirement for motion cueing effects due to atmospheric disturbances.

K. New Level 7 Fixed Wing FSTD Requirements—Appendix B Changes (Appendix B, Tables B1A, B1B, B2A, B3A, B3B, B3C, B3D, and B3E)

In addition to the changes proposed for FFS requirements in appendix A, the FAA is also proposing to add a new FTD qualification level (Level 7 FTD) in appendix B of part 60. This new FTD level would be modeled after the ICAO 9625, Edition 3 Type V FSTD and would incorporate all of the general requirements, objective testing requirements, and subjective testing requirements as defined in ICAO 9625, Edition 3 for this level of FSTD. The purpose of adding this new FSTD level would be to expand the number of training tasks that can be qualified for training in a lower cost, fixed-base FSTD. The highest FTD level currently defined in the part 60 FSTD qualification standards is the Level 6 FTD. Because the standards for a Level 6 FTD do not include minimum requirements for ground reaction and ground handling modeling and also do

not require objective testing to validate the FSTD's performance in related maneuvers such as takeoff, landing, and taxi training tasks, the Level 6 FTD cannot be used for training these tasks.

In order to qualify such an FTD for these training tasks, new evaluation requirements would be required to properly evaluate the aerodynamic ground effect, ground handling, and visual display system characteristics to ensure an adequate level of fidelity for related training maneuvers. In ICAO 9625, Edition 3, such a new FSTD level (the ICAO Type V FSTD) was defined to expand the number of introductory training tasks that can be conducted in a fixed base FSTD. The Type V FSTD evaluation guidance introduce new objective testing requirements in the takeoff, landing, and taxi flight maneuvers in a fixed base FTD that do not currently exist in a part 60 defined Level 6 FTD. This additional validation testing would allow for additional training to be qualified for such maneuvers beyond what a current FAA Level 6 FTD is capable of performing. Consistent with the ICAO Type V guidance material, some testing and checking tasks would still be limited to upper level FFSs that have the six degree of freedom motion cueing systems. The minimum requirements for the Type V FSTD as defined in the ICAO 9625, Edition 3 are essentially that of an ICAO Type VII simulator without motion cueing requirements and less restrictive visual display system requirements.

The addition of this new FTD qualification level would be beneficial to industry because it would provide FSTD Sponsors with more options for conducting lower cost training in fixed base FSTDs rather than using more expensive Level D FFS for certain training tasks. The qualification and use of such FTDs in an FAA approved training program would be voluntary and would not impose additional cost on FSTD Sponsors.

To incorporate the proposed addition of the Level 7 FTD into appendix B of part 60, the FAA is proposing to make several modifications to the existing tables to define the technical evaluation requirements for the new FTD level while keeping the requirements intact for the current Level 4, 5, and 6 FTDs. The FAA proposes the following changes to appendix B to achieve this objective:

- Minimum FTD Requirements (Table B1A): The FAA has rewritten the minimum FTD requirements table to use the ICAO 9625, Edition 3 format and numbering system. The FAA has integrated the new Level 7 FTD requirements into the table and based them on the proposed Level D FFS requirements as defined in Table A1A with the exception of the motion and visual display system requirements. The FAA is proposing to leave all other FTD levels essentially unchanged from the current part 60 requirements.
- Table of Tasks vs FTD Level (Table B1B): The FAA is proposing to modify the minimum qualified task list to include the new Level 7 FTD device. The FAA based the qualified tasks for the Level 7 FTD upon the recommendations in ICAO 9625, Edition 3 for a Type V FSTD. Where a specific training task is limited to training only and not qualified for training to proficiency tasks (testing or checking), the FAA is proposing to annotate it in the table with a ''T.''
- Objective Testing Requirements (Table B2A): The FAA is proposing to update the table of objective tests to include new testing requirements for the Level 7 FTD. The FAA based these requirements on the FFS Level D requirements proposed in Table A2A with the exception of the motion system and visual system requirements.
- Functions and Subjective Testing Requirements (Tables B3A, B3B, B3C, B3D, and B3E): The FAA is proposing to add new and updated subjective tests to address the new tasks that may be accomplished in a Level 7 FTD. The FAA left the existing requirements for Level 4, 5, and 6 FTDs unchanged.

L. Miscellaneous Amendments To Improve and Codify FSTD Evaluation Procedures (§§ 60.15, 60.17, 60.19, 60.23, Appendix A Paragraph 11)

The FAA is further proposing to make minor amendments to the FSTD evaluation and oversight process as defined in several sections of the main rule. The part 60 rule was originally published in 2008 and codified many of the existing FSTD evaluation practices that had previously been defined in guidance material. Since the rule originally became effective, the FAA has found a number of requirements in the rule that have had unintentional negative consequences in the FAA's ability to oversee FSTD qualification issues. The proposed changes would allow for more flexibility in scheduling FSTD evaluations and reduce some of the paperwork that FSTD Sponsors currently submit to the FAA. The changes being proposed would be less restrictive and would not have a cost impact on FSTD Sponsors.

- Corrects language in the initial evaluation requirements where FSTD objective testing must be accomplished at the ''sponsor's training facility.'' This has been corrected to the FSTD's ''permanent location'' to accommodate for FSTDs that are not located at the sponsor's training facility, but at a third party location. (§ 60.15 and appendix A, paragraph 11).
- Modifies the ''grace month'' for conducting annual Continuing Qualification (CQ) evaluations from one month to three months.
- Establishes the CQ evaluation schedule on the Statement of Qualification rather than in the Master Qualification Test Guide (MQTG). These changes would provide more flexibility in scheduling CQ evaluations to accommodate both the FAA and FSTD Sponsors. (§ 60.19).
- Amends the date before which previously qualified FSTDs retain the qualification basis under which they were originally evaluated. This would ensure that FSTDs which were qualified after the original publication of part 60 (May 30, 2008) do not inadvertently lose grandfather rights. (§ 60.17).
- Clarifies the requirement to notify the FAA of changes made to an FSTD's MQTG. This requirement has been modified to require FAA reporting only for changes that would have a material impact on the MQTG content or the FSTD's qualification basis. This change would reduce the amount of reporting the FSTD Sponsors would have to conduct for minor text changes in the MQTG document. (§ 60.23).
- Reduces the minimum time prior to an initial evaluation that an FSTD Sponsor is required to send a confirmation statement to the FAA that an FSTD has been evaluated in accordance with the part 60 QPS, provided there is prior coordination and approval by the NSPM. This change would allow more flexibility for the FSTD sponsors in complex FSTD installations where on-site testing cannot be accomplished before the current 5 day time limit. (appendix A, Paragraph 11).

IV. Regulatory Notices and Analyses

A. Regulatory Evaluation

Changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 and Executive Order 13563 direct that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 (Pub. L. 96–354) requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (Pub. L. 96–39) prohibits agencies

from setting standards that create unnecessary obstacles to the foreign commerce of the United States. In developing U.S. standards, this Trade Act requires agencies to consider international standards and, where appropriate, that they be the basis of U.S. standards. Fourth, the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local, or tribal governments, in the aggregate, or by the private sector, of $100 million or more annually (adjusted for inflation with base year of 1995). This portion of the preamble summarizes the FAA's analysis of the economic impacts of this proposed rule. We suggest readers seeking greater detail read the full regulatory evaluation, a copy of which we have placed in the docket for this rulemaking.

In conducting these analyses, FAA has determined this proposed rule has benefits that justify its costs. It has also been determined that this rule is not a ''significant regulatory action'' as defined in section 3(f) of Executive Order 12866, and is not ''significant'' as defined in DOT's Regulatory Policies and Procedures. The proposed rule, if adopted, will not have a significant economic impact on a substantial number of small entities, will not create unnecessary obstacles to international trade and will not impose an unfunded mandate on state, local, or tribal governments, or on the private sector.

Total Benefits and Costs of This Rule

Total Costs and Benefits

The FAA estimated three separate sets of costs, and provide separate benefit bases. The first set of costs would be incurred to make the necessary upgrades to the FSTDs to enable training required by the new Crewmember and Aircraft Dispatcher Training Final Rule. The training cost for the Crewmember and Aircraft Dispatcher Training Final Rule provides rental revenue to simulator sponsors which will fully compensate them for their FSTD upgrade expenses. These simulator revenues were accounted for as costs of the additional training and were fully justified by the benefits in that final rule. The second set of costs would be incurred for the evaluation and modification of engine and airframe icing models which would enhance existing training requirements for operations using anti-icing/de-icing equipment. Just avoiding one serious injury provides sufficient benefits to justify the estimated cost. Lastly there are a set of changes to part 60 QPS appendices which would align the simulator standards for some FSTD levels with those of the latest ICAO simulator evaluation guidance. This last set of changes would only apply to newly qualified FSTDs. The FAA expects unquantified safety improvements to result from these changes through more realistic training and possibly cost savings through avoiding conflicting compliance standards with other aviation authorities. The changes are expected to improve overall simulator fidelity with new and revised visual system and other FSTD evaluation standards, such as visual display resolution, visual system field of view, and system transport delay.

The table below summarizes the costs and benefits of this proposal over a ten year period:

		Present Value at a 7% Rate	Present Value at a 3% Rate
Total Cost	$52,378,480	$36,894,514	$44,892,676
Upgrade FSTDs for New Training Requirements			
Cost	$45,215,480	$32,286,867	$39,014,931
Benefits	Justified by the benefits of the training rule.		
Icing provisions			
Cost [1]	$468,000	$334,183	$403,822
Benefits	Only one prevented serious injury valued at $965,724 makes the icing benefits exceed the costs.		
Aligning Standards with ICAO			
Cost	$6,695,000	$4,273,464	$5,473,924
Benefits	Improved safety and cost savings		

[1] Implementing the icing upgrades can be accomplished at the same time as the non-icing upgrades. Therefore these estimates do not include the cost of implementation or FSTD downtime because these costs are included with the costs of the non-icing upgrades.

Note: Details may not add to row or column totals due to rounding

Costs

We now discuss the three separate sets of costs.

Upgrade Previously Qualified FSTDs for New Training Requirements. The first set of costs would be incurred to make the necessary upgrades to the FSTDs to enable training required by the new Crewmember and Aircraft Dispatcher Training Final Rule. In order to avoid inappropriate or negative training, FSTDs being used to comply with certain ''extended envelope'' training tasks in the new training rule would require evaluation and modification as defined in the FSTD Directive of this proposed part 60 rule.

Icing Provisions. The second set of costs would be incurred for the evaluation and modification of engine and airframe icing models which would enhance existing training requirements. These costs were estimated as a percentage of the total cost of the FSTD aerodynamic model development costs proposed by this rule. We did not include additional model implementation and FSTD downtime costs because it was assumed that these modifications would likely be conducted concurrently with the modifications required for the stall training tasks.

Aligning Standards With ICAO. Lastly there are a set of changes to part 60 QPS appendices which would align the simulator standards for some FSTD levels with those of the latest ICAO FSTD evaluation guidance document. These changes would only apply to newly qualified FSTDs.

Benefits

Upgrade Previously Qualified FSTDs for New Training Requirements. The best way to understand the benefits of this proposed rule is to view it in conjunction with the new Crewmember and Aircraft Dispatcher Training Final Rule. The costs of that training rule were justified by the expected benefits. The training rule cost/benefit analysis assumes that the simulators will be able to provide the required training at an hourly rate of $500. The part 60 proposed rule specifies the necessary simulator upgrade specifications. These upgrades require simulator owners to purchase and install upgrade packages, the costs of which are a cost of this proposed rule. Revenues received by simulator owners for providing training from the upgraded simulators are costs already incurred in the training rule that have been justified by the benefits of that rule. This revenue over time exceeds the cost of this proposed rule.

The proposed part 60 standards and upgrade simulator expense supporting the new training is $45 million ($32 million in present value at 7%) and has been fully justified by the new Crewmember and Aircraft Dispatcher Training Final Rule.

Icing Provisions. The second area for benefits is for the icing upgrade. Although this upgrade is not in response to a new training requirement, it would enhance existing training requirements for operations involving anti-icing/de-icing equipment and further address NTSB [19] [20] and ARC recommendations to the FAA.

These costs are minor at less than a million dollars and are expected to comprise a small percentage of the total cost of compliance with the FSTD Directive. One avoided serious injury would justify the minor costs of complying with these icing requirements.

Aligning Standards with ICAO. Lastly, we have not quantified benefits of aligning part 60 qualification standards with those recommended by ICAO, but we expect aligned FSTD standards to contribute to improved safety as they are developed by a broad coalition of experts with a combined pool of knowledge and experience and to result in cost savings through avoiding conflicting compliance standards with other aviation authorities. The changes are expected to improve overall simulator fidelity with new and revised visual system and other FSTD evaluation standards, such as visual display resolution, visual system field of view, and system transport delay.

B. Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (Pub. L. 96–354) (RFA) establishes ''as a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration.'' The RFA covers a wide-range of small entities, including small businesses, not-for-profit organizations, and small governmental jurisdictions.

Agencies must perform a review to determine whether a rule will have a significant economic impact on a substantial number of small entities. If the agency determines that it will, the agency must prepare a regulatory flexibility analysis as described in the RFA.

However, if an agency determines that a rule is not expected to have a significant economic impact on a substantial number of small entities, section 605(b) of the RFA provides that the head of the agency may so certify and a regulatory flexibility analysis is not required. The certification must include a statement providing the factual basis for this determination, and the reasoning should be clear.

Description and Estimate of the Number of Small Entities

Only FSTD sponsors are affected by this rule. FSTD sponsors are air carriers who own simulators to train their pilots or training centers who own simulators and sell simulator training time. To identify FSTD sponsors that would be affected retroactively by the FSTD directive,[21] the FAA subjected the 811 FSTDs with an active qualification by the FAA to qualifying criteria designed to eliminate FSTDs not likely to be used in a part 121 training program for the applicable training tasks (i.e., stall training, upset recovery training, etc.). The remaining list of 322 FSTDs (included in Appendix A of the regulatory evaluation) were sponsored by the 26 companies presented in the table below.

[19] NTSB recommendations A–11–46 and A–11–47 address engine and airframe icing.

[20] *www.ntsb.gov*

[21] Part 60 contains grandfather rights for previously qualified FSTD so the FAA would invoke an FSTD Directive to require modification of previously qualified devices. The FSTD Directive process has provisions for mandating modifications to FSTDs retroactively for safety of flight reasons. See 14 CFR Part 60, § 60.23(b).

Company Sponsoring FSTD	FSTD
A.T.S. Inc.	1
ABX Air, Inc.	2
AIMS Community College	1
Airbus	7
Alaska Airlines	3
American Airlines	24
American Eagle Airlines Training Center	2
Atlas Air, Inc	3
Boeing Training and Flight Services	37
CAE SimuFlite Inc.	7
Compass Airlines, LLC	1
Delta Air Lines, Inc.	28
Evergreen International Airlines	1
ExpressJet Airlines, Inc.	3
FedEx	20
FlightSafety International	67
FSC Dallas, LLC	3
Global One Training Group, LLC	1
JetBlue Airways	8
Kalitta Air, LLC	2
Pan Am International Flight Academy	31
Pinnacle Airlines, Inc.	2
Southwest Airlines	9
United Airlines	30
United Parcel Service	8
US Airways, Inc.	21
Total	322

To determine which of the 26 organizations listed in the previous table are small entities, the FAA consulted the U.S. Small Business Administration Table of Small Business Size Standards Matched to North American Industry Classification System Codes.[22] For flight training (NAICS Code 611512) the threshold for small business is revenue of $25.5 million or less. The size standard for scheduled passenger air transportation (NAICS Code 481111) and scheduled freight air transportation (NAICS Code 481112) and non-scheduled charter passenger air transportation (NAICS Code 481211) is 1,500 employees. After consulting the World Aviation Directory, and other on-line sources, for employees and annual revenues, the FAA identified six companies that are qualified as small entities. In this instance, the FAA considers six a substantial number of small entities.

Economic Impact

The economic impact of this rule applies differently to previously qualified FSTD sponsors than it would to newly qualified FSTD sponsors. Below is a summary of the two separate analyses performed. One determines the impact of the proposal on small entities that would have to upgrade their previously qualified devices and the other analysis determines the impact on those that would have to purchase a newly qualified devices.

Economic Impact of Upgrading Previously Qualified FSTDs

Four of the small entities are training providers. If these companies choose to offer training in the extended envelope training tasks as required by the Crewmember and Aircraft Dispatcher Training Final Rule, they could do so only in an upgraded FSTD. However, if they offer this new required training there would be increased demand for training time in their FSTDs because in addition to current requirements for training, captains and first officers have two hours of additional training in the first year and additional training time in the future. The FAA estimated the cost of upgrading each simulator would be recovered in less than 300 hours at a simulator rental rate of $500 per hour. The training companies could therefore recover their upgrade costs for each simulator in less than one year. Therefore, the rule would not impose a significant economic impact on these companies.

Two of the companies identified as small businesses are part 121 air carriers. They have to comply with the Crewmember and Aircraft Dispatcher Training Final Rule by training their pilots in simulators that meet the standards of this part 60 rule. The additional pilot training cost in an upgraded simulator was accounted for and justified in that training final rule. This part 60 rule simply specifies how the simulators need to be upgraded such that the new training will be in compliance with the training final rule. These part 121 operators have two options. They can purchase training time for their pilots at a qualified training center. Alternatively they could choose to comply with the FSTD Directive by upgrading their own devices to train their pilots for the new training tasks. For these operators who already own simulators, the cost of complying with the FSTD Directive is estimated to be less than the cost of renting time at a training center to comply with the new requirements. Therefore, we expect that they would choose to upgrade their devices because it would be less costly to offer training in-house than to send pilots out to

[22] *http://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf.*

training centers. The cost to train pilots in the tasks required by the training rule is a cost of the training rule and not this rule. Thus, the rule would not impose a significant economic impact on these companies, because by upgrading their simulators these operators would lower their costs.

Economics of Newly Qualified Devices

It is unknown how many sponsors of newly qualified FSTDs in the future may qualify as small entities, but we expect it would be a substantial number as it could likely include the six identified above. The FAA expects the proposed requirements that address the new training tasks and upgrade the icing FSTD requirements to be included in future training packages and the cost would be minimal for a newly qualified FSTD. The requirement to align with ICAO guidance however, would result in some cost. The FAA does not know who in the future will be purchasing and qualifying FSTDs after the rule becomes effective. The FAA estimates that the incremental cost per newly qualified FSTD would be approximately $34,000. This is less than 0.5 percent of the cost of a new FSTD, which generally costs $10 million or more. Therefore we do not believe the proposed rule would have a significant economic impact on a substantial number of small entities that purchase newly qualified FSTDs after the rule is in effect.

Thus this proposed rule is expected to impact a substantial number of small entities, but not impose a significant economic impact. Therefore, as provided in section 605(b), the head of the FAA certifies that this rulemaking will not result in a significant economic impact on a substantial number of small entities. The FAA solicits comments regarding this determination.

C. International Trade Impact Assessment

The Trade Agreements Act of 1979 (Pub. L. 96–39), as amended by the Uruguay Round Agreements Act (Pub. L. 103–465), prohibits Federal agencies from establishing standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Pursuant to these Acts, the establishment of standards is not considered an unnecessary obstacle to the foreign commerce of the United States, so long as the standard has a legitimate domestic objective, such as the protection of safety, and does not operate in a manner that excludes imports that meet this objective. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards. The FAA has assessed the potential effect of this proposed rule and determined that it uses international standards as its basis and does not create unnecessary obstacles to the foreign commerce of the United States.

D. Unfunded Mandates Assessment

Title II of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule that may result in an expenditure of $100 million or more (in 1995 dollars) in any one year by State, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a ''significant regulatory action.'' The FAA currently uses an inflation-adjusted value of $151 million in lieu of $100 million. This proposed rule does not contain such a mandate; therefore, the requirements of Title II of the Act do not apply.

E. Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. According to the 1995 amendments to the Paperwork Reduction Act (5 CFR 1320.8(b)(2)(vi)), an agency may not collect or sponsor the collection of information, nor may it impose an information collection requirement unless it displays a currently valid Office of Management and Budget (OMB) control number.

This action contains the following proposed amendments to the existing information collection requirements previously approved under OMB Control Number 2120–0680. As required by the Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)), the FAA has submitted these proposed information collection amendments to OMB for its review.

Summary: Under this proposal, an increase in information collection requirements would be imposed on Sponsors of previously qualified FSTDs that require modification for the qualification of certain training tasks as defined in FSTD Directive 2. These Sponsors would be required to report FSTD modifications to the FAA as described in § 60.23 and § 60.16 which would result in a one-time information collection. Additionally, because compliance with the FSTD Directive (for previously qualified FSTDs) and the new QPS requirements (for newly qualified FSTDs) would increase the overall amount of objective testing necessary to maintain FSTD qualification under § 60.19, a slight increase in annual information collection would be required to document such testing.

Use: For previously qualified FSTDs, the information collection would be used to determine that the requirements of the FSTD Directive have been met. The FAA will use this information to issue amended Statements of Qualification (SOQ) for those FSTDs that have been found to meet those requirements and also to determine if the FSTDs annual inspection and maintenance requirements have been met.

Respondents (including number of): The additional information collection burden in this proposal is limited to those FSTD Sponsors that would require specific FSTD qualification for certain training tasks as defined in FSTD Directive 2. Approximately 322 previously qualified FSTDs [23] may require evaluation as described in the FSTD Directive to support the Crewmember and Aircraft Dispatcher Training Final Rule. The number of respondents would be limited to those Sponsors that maintain FSTDs which may require additional qualification in accordance with the FSTD Directive.

Frequency: This additional information collection would include both a one-time event and an increase to the annual part 60 information collection requirements.

Annual Burden Estimate: The FAA estimates that for each additional qualified task required in accordance with FSTD Directive 2, the one-time information collection burden to each FSTD Sponsor would be approximately 0.85 hours per FSTD for each additional qualified task.[24] Assuming all five of the additional qualified tasks would be required for each of the estimated 322 FSTDs (including qualification for full stall training, upset recovery training, airborne icing training, takeoff and landing in gusting crosswinds, and bounced landing training), the cumulative one-time information collection burden would be approximately 1,369 hours. This collection burden would be distributed over a time period of approximately 3

[23] The FAA estimated this from the number of previously qualified FSTDs that simulate aircraft which are currently used in U.S. part 121 air carrier operations.

[24] The 0.85 hour burden is derived from the existing Part 60 Paperwork Reduction Act supporting statement (OMB–2120–0680), Table 5 (§ 60.16) and includes estimated time for the FSTD Sponsor's staff to draft and send the letter as well as estimated time for updating the approved MQTG with new test results.

years. This 3 year time period represents the compliance period of the proposed FSTD Directive.

The one-time information collection burden to the Federal government is estimated at approximately 0.6 hours per FSTD for each qualified task to include Aerospace Engineer review and preparation of an FAA response.[25] Assuming all five of the additional qualified tasks would be required for each of the estimated 322 FSTDs, the cumulative one-time information collection burden to the Federal government would be approximately 966 hours. The modification of the FSTD's Statement of Qualification would be incorporated with the FSTD's next scheduled evaluation, so this would not impose additional burden.

Because the number of objective tests required to maintain FSTD qualification would increase slightly with this proposal, the annual information collection burden would also increase under the FSTD inspection and maintenance requirements of § 60.19. This additional information collection burden is estimated by increasing the average number of required objective tests for Level C and Level D FSTDs by four tests.[26] For the estimated 322 FSTDs that may be affected by the FSTD Directive, this will result in an additional 129 hours of annual information collection burden to FSTD Sponsors. This additional collection burden is based upon 0.1 hours[27] per test for a simulator technician to document as required by § 60.19. The additional information collection burden to the Federal government would also increase by approximately 43 hours[28] due to the additional tests that may be sampled and reviewed by the FAA during continuing qualification evaluations.

For new FSTDs qualified after the proposal becomes effective, the changes to the QPS appendices proposed to align with ICAO 9625 as well as the new requirements for the evaluation of stall and icing training maneuvers would result in an estimated average increase of four objective tests[29] that would require annual documentation as described in § 60.19. For the estimated 22 new[30] Level C and Level D FSTDs that may be initially qualified annually by the FAA, this will result in an additional 9 hours of annual information collection burden to FSTD Sponsors and an additional 3 hours of annual information collection burden to the Federal government. For newly qualified FSTDs, this proposal does not increase the frequency of reporting for FSTD sponsors.

The agency is soliciting comments to—

(1) Evaluate whether the proposed information requirement is necessary for the proper performance of the functions of the agency, including whether the information would have practical utility;

(2) Evaluate the accuracy of the agency's estimate of the burden;

(3) Enhance the quality, utility, and clarity of the information to be collected; and

(4) Minimize the burden of collecting information on those who are to respond, including by using appropriate automated, electronic, mechanical, or other technological collection techniques or other forms of information technology.

Individuals and organizations may send comments on the information collection requirement to the address listed in the **ADDRESSES** section at the beginning of this preamble by October 8, 2014. Comments also should be submitted to the Office of Management and Budget, Office of Information and Regulatory Affairs, Attention: Desk Officer for FAA, New Executive Building, Room 10202, 725 17th Street NW., Washington, DC 20053.

F. International Compatibility and Cooperation

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to conform to ICAO Standards and Recommended Practices to the maximum extent practicable. The FAA has determined that there are no ICAO Standards and Recommended Practices that correspond to these proposed changes to the part 60 regulations. While the FAA has proposed to align the part 60 qualification standards for Level 7 FTDs and Level D fixed wing FFSs with that of ICAO Document 9625, the FSTD qualification guidance contained within ICAO 9625 are not defined in an ICAO Annex as a Standard and Recommended Practice and are considered guidance material.

Executive Order 13609, Promoting International Regulatory Cooperation, (77 FR 26413, May 4, 2012) promotes international regulatory cooperation to meet shared challenges involving health, safety, labor, security, environmental, and other issues and reduce, eliminate, or prevent unnecessary differences in regulatory requirements. The FAA has analyzed this action under the policy and agency responsibilities of Executive Order 13609, Promoting International Regulatory Cooperation. The agency has determined that this action would promote the elimination of differences between U.S. aviation standards and those of other civil aviation authorities by aligning evaluation standards for similar FSTD fidelity levels to the latest internationally recognized FSTD evaluation guidance in the ICAO 9625 document.

G. Environmental Analysis

FAA Order 1050.1E identifies FAA actions that are categorically excluded from preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act in the absence of extraordinary circumstances. The FAA has determined this rulemaking action qualifies for the categorical exclusion identified in paragraph 312f and involves no extraordinary circumstances.

V. Executive Order Determinations

A. Executive Order 13132, Federalism

The FAA has analyzed this proposed rule under the principles and criteria of Executive Order 13132, Federalism. The agency has determined that this action would not have a substantial direct effect on the States, or the relationship between the Federal Government and the States, or on the distribution of power and responsibilities among the various levels of government, and, therefore, would not have Federalism implications.

[25] The 0.6 hour burden on the Federal government is also derived from the existing Part 60 Paperwork Reduction Act supporting statement (OMB–2120–0680), Table 5 (§ 60.16).

[26] For previously qualified FSTDs, the requirements of FSTD Directive #2 will add a maximum of four additional objective test cases to the existing requirements.

[27] The 0.1 hour burden is derived from the existing Part 60 Paperwork Reduction Act supporting statement (OMB–2120–0680), Table 6 (§ 60.19) and includes estimated time for the FSTD Sponsor's staff to document the completion of required annual objective testing.

[28] This information collection burden is based upon 0.1 hours per test required for FAA personnel to review. These four additional tests are subject to the approximately 33% of which may be spot checked by FAA personnel on site during a continuing qualification evaluation.

[29] These four additional tests were estimated through comparison between the current and proposed list of objective tests required for qualification (Table A2A). Note that the total number of tests can vary between FSTDs as a function of aircraft type, test implementation, and the employment of certain technologies that would require additional testing.

[30] Based upon internal records review, the FAA calculated the number of newly qualified FSTDs at approximately 22 per year over a ten year period.

B. Executive Order 13211, Regulations That Significantly Affect Energy Supply, Distribution, or Use

The FAA analyzed this proposed rule under Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use (May 18, 2001). The agency has determined that it would not be a ''significant energy action'' under the executive order and would not be likely to have a significant adverse effect on the supply, distribution, or use of energy.

VI. Additional Information

A. Comments Invited

The FAA invites interested persons to participate in this rulemaking by submitting written comments, data, or views. The agency also invites comments relating to the economic, environmental, energy, or federalism impacts that might result from adopting the proposals in this document. The most helpful comments reference a specific portion of the proposal, explain the reason for any recommended change, and include supporting data. To ensure the docket does not contain duplicate comments, commenters should send only one copy of written comments, or if comments are filed electronically, commenters should submit only one time.

The FAA will file in the docket all comments it receives, as well as a report summarizing each substantive public contact with FAA personnel concerning this proposed rulemaking. Before acting on this proposal, the FAA will consider all comments it receives on or before the closing date for comments. The FAA will consider comments filed after the comment period has closed if it is possible to do so without incurring expense or delay. The agency may change this proposal in light of the comments it receives.

Proprietary or Confidential Business Information: Commenters should not file proprietary or confidential business information in the docket. Such information must be sent or delivered directly to the person identified in the **FOR FURTHER INFORMATION CONTACT** section of this document, and marked as proprietary or confidential. If submitting information on a disk or CD ROM, mark the outside of the disk or CD ROM, and identify electronically within the disk or CD ROM the specific information that is proprietary or confidential.

Under 14 CFR 11.35(b), if the FAA is aware of proprietary information filed with a comment, the agency does not place it in the docket. It is held in a separate file to which the public does not have access, and the FAA places a note in the docket that it has received it. If the FAA receives a request to examine or copy this information, it treats it as any other request under the Freedom of Information Act (5 U.S.C. 552). The FAA processes such a request under Department of Transportation procedures found in 49 CFR part 7.

B. Availability of Rulemaking Documents

An electronic copy of rulemaking documents may be obtained from the Internet by—

1. Searching the Federal eRulemaking Portal (*http://www.regulations.gov*);

2. Visiting the FAA's Regulations and Policies Web page at *http://www.faa.gov/regulations_policies* or

3. Accessing the Government Printing Office's Web page at *http://www.fdsys.gov*.

Copies may also be obtained by sending a request to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue SW., Washington, DC 20591, or by calling (202) 267–9680. Commenters must identify the docket or notice number of this rulemaking.

All documents the FAA considered in developing this proposed rule, including economic analyses and technical reports, may be accessed from the Internet through the Federal eRulemaking Portal referenced in item (1) above.

List of Subjects in 14 CFR Part 60

Airmen, Aviation safety, Reporting and recordkeeping requirements.

The Proposed Amendment

In consideration of the foregoing, the Federal Aviation Administration proposes to amend chapter I of title 14, Code of Federal Regulations as follows:

PART 60—FLIGHT SIMULATION TRAINING DEVICE INITIAL AND CONTINUING QUALIFICATION AND USE

■ 1. The authority citation for part 60 is revised to read as follows:

Authority: 49 U.S.C. 106(f), 106(g), 40113, and 44701; Pub. L. 111–216, 124 Stat. 2348 (49 U.S.C. 44701 note).

■ 2. Amend § 60.15 by revising paragraph (e) to read as follows:

§ 60.15 Initial Qualification requirements.

* * * * *

(e) The subjective tests that form the basis for the statements described in paragraph (b) of this section and the objective tests referenced in paragraph (f) of this section must be accomplished at the FSTD's permanent location, except as provided for in the applicable QPS.

* * * * *

■ 3. Amend § 60.17 by revising paragraph (a) to read as follows:

§ 60.17 Previously qualified FSTDs.

(a) Unless otherwise specified by an FSTD Directive, further referenced in the applicable QPS, or as specified in paragraph (e) of this section, an FSTD qualified before [effective date of final rule] will retain its qualification basis as long as 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. The sponsor of such an FSTD must comply with the other applicable provisions of this part.

■ 4. Amend § 60.19 by revising paragraphs (b)(4) and (b)(5) to read as follows:

§ 60.19 Inspection, continuing qualification evaluation, and maintenance requirements.

* * * * *

(b) * * *

(4) The frequency of NSPM-conducted continuing qualification evaluations for each FSTD will be established by the NSPM and specified in the Statement of Qualification.

(5) Continuing qualification evaluations conducted in the 3 calendar months before or after the calendar month in which these continuing qualification evaluations are required will be considered to have been conducted in the calendar month in which they were required.

* * * * *

■ 5. Amend § 60.23 by adding new paragraph (a)(3) to read as follows:

§ 60.23 Modifications to FSTDs.

(a) * * *

(3) 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.

* * * * *

■ 6. Part 60 is amended by revising Appendix A to read as follows:

Appendix A to Part 60—Qualification Performance Standards for Airplane Full Flight Simulators

Begin Information

This appendix establishes the standards for Airplane FFS evaluation and qualification. The NSPM is responsible for the development, application, and

implementation of the standards contained within this appendix. The procedures and criteria specified in this appendix will be used by the NSPM, or a person assigned by the NSPM, when conducting airplane FFS evaluations.

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21. Record Keeping and Reporting (§ 60.31).
22. Applications, Logbooks, Reports, and Records: Fraud, Falsification, or Incorrect Statements (§ 60.33).
23. Specific FFS Compliance Requirements (§ 60.35).
24. [Reserved]
25. FFS Qualification on the Basis of a Bilateral Aviation Safety Agreement (BASA) (§ 60.37).
Attachment 1 to Appendix A to Part 60—General Simulator Requirements.
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Attachment 6 to Appendix A to Part 60—FSTD Directives Applicable to Airplane Flight Simulators.
Attachment 7 to Appendix A to Part 60—Additional Simulator Qualification Requirements for Stall, Upset Recognition and Recovery, and Engine and Airframe Icing Training Tasks.

End Information

1. Introduction

Begin Information

a. This appendix contains background information as well as regulatory and informative material as described later in this section. To assist the reader in determining what areas are required and what areas are permissive, the text in this appendix is divided into two sections: ''QPS Requirements'' and ''Information.'' The QPS Requirements sections contain details regarding compliance with the part 60 rule language. These details are regulatory, but are found only in this appendix. The Information sections contain material that is advisory in nature, and designed to give the user general information about the regulation.

b. Questions regarding the contents of this publication should be sent to the U.S. Department of Transportation, Federal Aviation Administration, Flight Standards Service, National Simulator Program Staff, AFS–205, 100 Hartsfield Centre Parkway, Suite 400, Atlanta, Georgia, 30354. Telephone contact numbers for the NSP are: Phone, 404–832–4700; fax, 404–761–8906. The general email address for the NSP office is: *9-aso-avs-sim-team@faa.gov.* The NSP Internet Web site address is: *http://www.faa.gov/about/initiatives/nsp/.* On this Web site you will find an NSP personnel list with telephone and email contact information for each NSP staff member, a list of qualified flight simulation devices, advisory circulars (ACs), a description of the qualification process, NSP policy, and an NSP ''In-Works'' section. Also linked from this site are additional information sources, handbook bulletins, frequently asked questions, a listing and text of the Federal Aviation Regulations, Flight Standards Inspector's handbooks, and other FAA links.

c. The NSPM encourages the use of electronic media for all communication, including any record, report, request, test, or statement required by this appendix. The electronic media used must have adequate security provisions and be acceptable to the NSPM. The NSPM recommends inquiries on system compatibility, and minimum system requirements are also included on the NSP Web site.

d. Related Reading References.

(1) 14 CFR part 60.

(2) 14 CFR part 61.

(3) 14 CFR part 63.

(4) 14 CFR part 119.

(5) 14 CFR part 121.

(6) 14 CFR part 125.

(7) 14 CFR part 135.

(8) 14 CFR part 141.

(9) 14 CFR part 142.

(10) AC 120–28, as amended, Criteria for Approval of Category III Landing Weather Minima.

(11) AC 120–29, as amended, Criteria for Approving Category I and Category II Landing Minima for part 121 operators.

(12) AC 120–35, as amended, Line Operational Simulations: Line-Oriented Flight Training, Special Purpose Operational Training, Line Operational Evaluation.

(13) AC 120–40, as amended, Airplane Simulator Qualification.

(14) AC 120–41, as amended, Criteria for Operational Approval of Airborne Wind Shear Alerting and Flight Guidance Systems.

(15) AC 120–57, as amended, Surface Movement Guidance and Control System (SMGCS).

(16) AC 150/5300–13, as amended, Airport Design.

(17) AC 150/5340–1, as amended, Standards for Airport Markings.

(18) AC 150/5340–4, as amended, Installation Details for Runway Centerline Touchdown Zone Lighting Systems.

(19) AC 150/5340–19, as amended, Taxiway Centerline Lighting System.

(20) AC 150/5340–24, as amended, Runway and Taxiway Edge Lighting System.

(21) AC 150/5345–28, as amended, Precision Approach Path Indicator (PAPI) Systems.

(22) International Air Transport Association document, ''Flight Simulator Design and Performance Data Requirements,'' as amended.

(23) AC 25–7, as amended, Flight Test Guide for Certification of Transport Category Airplanes.

(24) AC 23–8, as amended, Flight Test Guide for Certification of Part 23 Airplanes.

(25) International Civil Aviation Organization (ICAO) Manual of Criteria for the Qualification of Flight Simulators, as amended.

(26) Airplane Flight Simulator Evaluation Handbook, Volume I, as amended and Volume II, as amended, The Royal Aeronautical Society, London, UK.

(27) FAA Publication FAA–S–8081 series (Practical Test Standards for Airline Transport Pilot Certificate, Type Ratings, Commercial Pilot, and Instrument Ratings).

(28) The FAA Aeronautical Information Manual (AIM). An electronic version of the AIM is on the internet at *http://www.faa.gov/atpubs.*

(29) Aeronautical Radio, Inc. (ARINC) document number 436, titled Guidelines For Electronic Qualification Test Guide (as amended).

(30) Aeronautical Radio, Inc. (ARINC) document 610, Guidance for Design and Integration of Aircraft Avionics Equipment in Simulators (as amended).

End Information

2. Applicability (§§ 60.1 and 60.2)

Begin Information

No additional regulatory or informational material applies to § 60.1, Applicability, or to § 60.2, Applicability of sponsor rules to person who are not sponsors and who are engaged in certain unauthorized activities.

End Information

3. Definitions (§ 60.3)

Begin Information

See Appendix F of this part for a list of definitions and abbreviations from part 1 and part 60, including the appropriate appendices of part 60.

End Information

4. Qualification Performance Standards (§ 60.4)

Begin Information

No additional regulatory or informational material applies to § 60.4, Qualification Performance Standards.

End Information

5. Quality Management System (§ 60.5)

Begin Information

See Appendix E of this part for additional regulatory and informational material regarding Quality Management Systems.

End Information

6. Sponsor Qualification Requirements (§ 60.7)

Begin Information

a. The intent of the language in § 60.7(b) is to have a specific FFS, identified by the sponsor, used at least once in an FAA-approved flight training program for the airplane simulated during the 12-month period described. The identification of the specific FFS may change from one 12-month period to the next 12-month period as long as the sponsor sponsors and uses at least one FFS at least once during the prescribed period. No minimum number of hours or minimum FFS periods are required.

b. The following examples describe acceptable operational practices:

(1) Example One.

(a) A sponsor is sponsoring a single, specific FFS for its own use, in its own facility or elsewhere—this single FFS forms the basis for the sponsorship. The sponsor uses that FFS at least once in each 12-month period in the sponsor's FAA-approved flight training program for the airplane simulated. This 12-month period is established according to the following schedule:

(i) If the FFS was qualified prior to May 30, 2008, the 12-month period begins on the date of the first continuing qualification evaluation conducted in accordance with § 60.19 after May 30, 2008, and continues for each subsequent 12-month period;

(ii) A device qualified on or after May 30, 2008, will be required to undergo an initial or upgrade evaluation in accordance with § 60.15. Once the initial or upgrade evaluation is complete, the first continuing qualification evaluation will be conducted within 6 months. The 12 month continuing qualification evaluation cycle begins on that date and continues for each subsequent 12-month period.

(b) There is no minimum number of hours of FFS use required.

(c) The identification of the specific FFS may change from one 12-month period to the next 12-month period as long as the sponsor sponsors and uses at least one FFS at least once during the prescribed period.

(2) Example Two.

(a) A sponsor sponsors an additional number of FFSs, in its facility or elsewhere. Each additionally sponsored FFS must be—

(i) Used by the sponsor in the sponsor's FAA-approved flight training program for the airplane simulated (as described in § 60.7(d)(1));

OR

(ii) Used by another FAA certificate holder in that other certificate holder's FAA-approved flight training program for the airplane simulated (as described in § 60.7(d)(1)). This 12-month period is established in the same manner as in example one;

OR

(iii) Provided a statement each year from a qualified pilot, (after having flown the airplane, not the subject FFS or another FFS, during the preceding 12-month period) stating that the subject FFSs performance and handling qualities represent the airplane (as described in § 60.7(d)(2)). This statement is provided at least once in each 12-month period established in the same manner as in example one.

(b) No minimum number of hours of FFS use is required.

(3) Example Three.

(a) A sponsor in New York (in this example, a Part 142 certificate holder) establishes ''satellite'' training centers in Chicago and Moscow.

(b) The satellite function means that the Chicago and Moscow centers must operate under the New York center's certificate (in accordance with all of the New York center's practices, procedures, and policies; e.g., instructor and/or technician training/checking requirements, record keeping, QMS program).

(c) All of the FFSs in the Chicago and Moscow centers could be dry-leased (i.e., the certificate holder does not have and use FAA-approved flight training programs for the FFSs in the Chicago and Moscow centers) because—

(i) Each FFS in the Chicago center and each FFS in the Moscow center is used at least once each 12-month period by another FAA certificate holder in that other certificate holder's FAA-approved flight training program for the airplane (as described in § 60.7(d)(1));

OR

(ii) A statement is obtained from a qualified pilot (having flown the airplane, not the subject FFS or another FFS during the preceding 12-month period) stating that the performance and handling qualities of each FFS in the Chicago and Moscow centers represents the airplane (as described in § 60.7(d)(2)).

End Information

7. Additional Responsibilities of the Sponsor (§ 60.9)

Begin Information

The phrase ''as soon as practicable'' in § 60.9(a) means without unnecessarily disrupting or delaying beyond a reasonable time the training, evaluation, or experience being conducted in the FFS.

End Information

8. FFS Use (§ 60.11)

Begin Information

No additional regulatory or informational material applies to § 60.11, Simulator Use.

End Information

9. FFS Objective Data Requirements (§ 60.13)

Begin QPS Requirements

a. 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:

(1) A flight test plan consisting of:

(a) The maneuvers and procedures required for aircraft certification and simulation programming and validation.

(b) 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 airplane configuration, including weight and center of gravity.

(v) The data to be gathered.

(vi) All other information necessary to recreate the flight test conditions in the FFS.

(2) Appropriately qualified flight test personnel.

(3) An understanding of the accuracy of the data to be gathered using appropriate alternative data sources, procedures, and instrumentation that is traceable to a recognized standard as described in Attachment 2, Table A2E of this appendix.

(4) Appropriate and sufficient data acquisition equipment or system(s), including appropriate data reduction and analysis methods and techniques, as would be acceptable to the FAA's Aircraft Certification Service.

b. The data, regardless of source, must be presented as follows:

(1) In a format that supports the FFS 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 Attachment 2, Table A2A of this appendix.

(4) With any necessary instructions or other details provided, such as yaw damper or throttle position.

(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 in support of 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 § 60.13(f), the sponsor must notify the NSPM when it becomes aware that an addition to, an amendment to, or a revision of data that may relate to FFS performance or handling characteristics is available. The data referred to in this paragraph is data used to validate the performance, handling qualities, or other characteristics of the aircraft, including data related to any relevant changes occurring after the type certificate was issued. The sponsor must—

(1) Within 10 calendar days, notify the NSPM of the existence of this data; and

(2) Within 45 calendar days, notify the NSPM of—

(a) The schedule to incorporate this data into the FFS; or

(b) The reason for not incorporating this data into the FFS.

e. In those cases where the objective test results authorize a ''snapshot test'' or a ''series of snapshot tests'' results in lieu of a time-history result, the sponsor or other data provider must ensure that a steady state condition exists at the instant of time captured by the ''snapshot.'' The steady state condition must exist from 4 seconds prior to, through 1 second following, the instant of time captured by the snapshot.

End QPS Requirements

Begin Information

f. The FFS sponsor is encouraged to maintain a liaison with the manufacturer of the aircraft being simulated (or with the holder of the aircraft type certificate for the aircraft being simulated if the manufacturer is no longer in business), and, if appropriate, with the person having supplied the aircraft data package for the FFS in order to facilitate the notification required by § 60.13(f).

g. It is the intent of the NSPM that for new aircraft entering service, at a point well in advance of preparation of the Qualification Test Guide (QTG), the sponsor should submit to the NSPM for approval, a descriptive document (see Table A2C, Sample Validation Data Roadmap for Airplanes) containing the plan for acquiring the validation data, including data sources. This document 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. Additionally, this document should 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.

h. There is no requirement for any flight test data supplier to submit a flight test plan or program prior to gathering flight test data. However, the NSPM notes that inexperienced data gatherers often provide data that is irrelevant, improperly marked, or lacking adequate justification for selection. Other problems include inadequate information regarding initial conditions or test maneuvers. The NSPM has been forced to refuse these data submissions as validation data for an FFS evaluation. It is for this reason that the NSPM recommends that any data supplier not previously experienced in this area review the data necessary for programming and for validating the performance of the FFS, and discuss the flight test plan anticipated for acquiring such data with the NSPM well in advance of commencing the flight tests.

i. The NSPM will consider, on a case-by-case basis, whether to approve supplemental validation data derived from flight data recording systems, such as a Quick Access Recorder or Flight Data Recorder.

End Information

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10. Special Equipment and Personnel Requirements for Qualification of the FFSs (§ 60.14)

Begin Information

a. In the event that the NSPM determines that special equipment or specifically qualified persons will be required to conduct an evaluation, the NSPM will make every attempt to notify the sponsor at least one (1) week, but in no case less than 72 hours, in advance of the evaluation. Examples of special equipment include spot photometers, flight control measurement devices, and sound analyzers. Examples of specially qualified personnel include individuals specifically qualified to install or use any special equipment when its use is required.

b. Examples of a special evaluation include an evaluation conducted after an FFS is moved, at the request of the TPAA, or as a result of comments received from users of the FFS that raise questions about the continued qualification or use of the FFS.

End Information

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11. Initial (and Upgrade) Qualification Requirements (§ 60.15)

Begin QPS Requirements

a. In order to be qualified at a particular qualification level, the FFS must:

(1) Meet the general requirements listed in Attachment 1 of this appendix;

(2) Meet the objective testing requirements listed in Attachment 2 of this appendix; and

(3) Satisfactorily accomplish the subjective tests listed in Attachment 3 of this appendix.

b. The request described in § 60.15(a) must include all of the following:

(1) A statement that the FFS meets all of the applicable provisions of this part and all applicable provisions of the QPS.

(2) Unless otherwise authorized through prior coordination with the NSPM, a confirmation that the sponsor will forward to the NSPM the statement described in § 60.15(b) in such time as to be received no later than 5 business days prior to the scheduled evaluation and may be forwarded to the NSPM via traditional or electronic means.

(3) A QTG, acceptable to the NSPM, that includes all of the following:

(a) Objective data obtained from traditional aircraft testing or another approved source.

(b) Correlating objective test results obtained from the performance of the FFS as prescribed in the appropriate QPS.

(c) The result of FFS subjective tests prescribed in the appropriate QPS.

(d) A description of the equipment necessary to perform the evaluation for initial qualification and the continuing qualification evaluations.

c. The QTG described in paragraph (a)(3) of this section, must provide the documented proof of compliance with the simulator objective tests in Attachment 2, Table A2A of this appendix.

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

(1) Parameters, tolerances, and flight conditions;

(2) Pertinent and complete instructions for the conduct of automatic and manual tests;

(3) A means of comparing the FFS test results to the objective data;

(4) Any other information as necessary, to assist in the evaluation of the test results;

(5) Other information appropriate to the qualification level of the FFS.

e. The QTG described in paragraphs (a)(3) and (b) of this section, must include the following:

(1) A QTG cover page with sponsor and FAA approval signature blocks (see Attachment 4, Figure A4C, of this appendix for a sample QTG cover page).

(2) A continuing qualification evaluation requirements page. This page will be used by the NSPM to establish and record the frequency with which continuing qualification evaluations must be conducted and any subsequent changes that may be determined by the NSPM in accordance with § 60.19. See Attachment 4, Figure A4G, of this appendix for a sample Continuing Qualification Evaluation Requirements page.

(3) An FFS information page that provides the information listed in this paragraph (see Attachment 4, Figure A4B, of this appendix for a sample FFS information page). For convertible FFSs, the sponsor must submit a separate page for each configuration of the FFS.

(a) The sponsor's FFS identification number or code.

(b) The airplane model and series being simulated.

(c) The aerodynamic data revision number or reference.

(d) The source of the basic aerodynamic model and the aerodynamic coefficient data used to modify the basic model.

(e) The engine model(s) and its data revision number or reference.

(f) The flight control data revision number or reference.

(g) The flight management system identification and revision level.

(h) The FFS model and manufacturer.
(i) The date of FFS manufacture.
(j) The FFS computer identification.
(k) The visual system model and manufacturer, including display type.
(l) The motion system type and manufacturer, including degrees of freedom.
(4) A Table of Contents.
(5) A log of revisions and a list of effective pages.
(6) A list of all relevant data references.
(7) A glossary of terms and symbols used (including sign conventions and units).
(8) Statements of Compliance and Capability (SOCs) with certain requirements.
(9) Recording procedures or equipment required to accomplish the objective tests.
(10) The following information for each objective test designated in Attachment 2, Table A2A, of this appendix as applicable to the qualification level sought:
(a) Name of the test.
(b) Objective of the test.
(c) Initial conditions.
(d) Manual test procedures.
(e) Automatic test procedures (if applicable).
(f) Method for evaluating FFS objective test results.
(g) List of all relevant parameters driven or constrained during the automatically conducted test(s).
(h) List of all relevant parameters driven or constrained during the manually conducted test(s).
(i) Tolerances for relevant parameters.
(j) Source of Validation Data (document and page number).
(k) 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).
(l) 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.

f. A convertible FFS is addressed as a separate FFS for each model and series airplane to which it will be converted and for the FAA qualification level sought. If a sponsor seeks qualification for two or more models of an airplane type using a convertible FFS, the sponsor must submit a QTG for each airplane model, or a QTG for the first airplane model and a supplement to that QTG for each additional airplane model. The NSPM will conduct evaluations for each airplane model.

g. Form and manner of presentation of objective test results in the QTG:

(1) The sponsor's FFS test results must be recorded in a manner acceptable to the NSPM, 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).

(2) FFS results must be labeled using terminology common to airplane parameters as opposed to computer software identifications.

(3) 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.

(4) Scaling on graphical presentations must provide the resolution necessary to evaluate the parameters shown in Attachment 2, Table A2A of this appendix.

(5) 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 airplane with respect to time. Time histories recorded via a line printer are to be clearly identified for cross plotting on the airplane data. Over-plots must not obscure the reference data.

h. The sponsor may elect to complete the QTG objective and subjective tests at the manufacturer's facility or at the sponsor's training facility. 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 NSPM.

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

j. All FFSs for which the initial qualification is conducted after May 30, 2014, must have an electronic MQTG (eMQTG) including all objective data obtained from airplane testing, or another approved source (reformatted or digitized), together with correlating objective test results obtained from the performance of the FFS (reformatted or digitized) as prescribed in this appendix. The eMQTG must also contain the general FFS performance or demonstration results (reformatted or digitized) prescribed in this appendix, and a description of the equipment necessary to perform the initial qualification evaluation and the continuing qualification evaluations. The eMQTG must include the original validation data used to validate FFS performance and handling qualities in either the original digitized format from the data supplier or an electronic scan of the original time-history plots that were provided by the data supplier. A copy of the eMQTG must be provided to the NSPM.

k. All other FFSs not covered in subparagraph ''j'' must have an electronic copy of the MQTG by May 30, 2014. An electronic copy of the MQTG must be provided to the NSPM. This may be provided by an electronic scan presented in a Portable Document File (PDF), or similar format acceptable to the NSPM.

l. During the initial (or upgrade) qualification evaluation conducted by the NSPM, 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.

End QPS Requirements

Begin Information

m. Only those FFSs that are sponsored by a certificate holder as defined in Appendix F of this part will be evaluated by the NSPM. However, other FFS evaluations may be conducted on a case-by-case basis as the Administrator deems appropriate, but only in accordance with applicable agreements.

n. The NSPM will conduct an evaluation for each configuration, and each FFS must be evaluated as completely as possible. To ensure a thorough and uniform evaluation, each FFS is subjected to the general simulator requirements in Attachment 1 of this appendix, the objective tests listed in Attachment 2 of this appendix, and the subjective tests listed in Attachment 3 of this appendix. The evaluations described herein will include, but not necessarily be limited to the following:

(1) Airplane responses, including longitudinal and lateral-directional control responses (see Attachment 2 of this appendix);

(2) Performance in authorized portions of the simulated airplane's operating envelope, to include tasks evaluated by the NSPM in the areas of surface operations, takeoff, climb, cruise, descent, approach, and landing as well as abnormal and emergency operations (see Attachment 2 of this appendix);

(3) Control checks (see Attachment 1 and Attachment 2 of this appendix);

(4) Flight deck configuration (see Attachment 1 of this appendix);

(5) Pilot, flight engineer, and instructor station functions checks (see Attachment 1 and Attachment 3 of this appendix);

(6) Airplane systems and sub-systems (as appropriate) as compared to the airplane simulated (see Attachment 1 and Attachment 3 of this appendix);

(7) FFS systems and sub-systems, including force cueing (motion), visual, and aural (sound) systems, as appropriate (see Attachment 1 and Attachment 2 of this appendix); and

(8) 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.

o. The NSPM administers the objective and subjective tests, which includes an examination of functions. The tests include a qualitative assessment of the FFS by an NSP pilot. The NSP 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.

(1) Objective tests provide a basis for measuring and evaluating FFS performance and determining compliance with the requirements of this part.

(2) Subjective tests provide a basis for:

(a) Evaluating the capability of the FFS to perform over a typical utilization period;

(b) Determining that the FFS satisfactorily simulates each required task;

(c) Verifying correct operation of the FFS controls, instruments, and systems; and

(d) Demonstrating compliance with the requirements of this part.

p. The tolerances for the test parameters listed in Attachment 2 of this appendix reflect the range of tolerances acceptable to the NSPM 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 NSPM 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 way the data was gathered and applied) data presentations, and the applicable tolerances for each test.

q. In addition to the scheduled continuing qualification evaluation, each FFS is subject to evaluations conducted by the NSPM 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 flightcrew member training, testing, or 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 check airman, instructor, Aircrew Program Designee (APD), or FAA inspector aboard the FFS along with the student(s) and observing the operation of the FFS during the training, testing, or checking activities.

r. Problems with objective test results are handled as follows:

(1) If a problem with an objective test result is detected by the NSP evaluation team during an evaluation, the test may be repeated or the QTG may be amended.

(2) If it is determined that the results of an objective test do not support the level requested but do support a lower level, the NSPM 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.

s. After an FFS is successfully evaluated, the NSPM issues a Statement of Qualification (SOQ) to the sponsor. The NSPM recommends the FFS to the TPAA, who will approve the FFS for use in a flight training program. The SOQ will be issued at the satisfactory conclusion of the initial or continuing qualification evaluation and will list the tasks for which the FFS is qualified, referencing the tasks described in Table A1B in Attachment 1 of this appendix. However, it is the sponsor's responsibility to obtain TPAA approval prior to using the FFS in an FAA-approved flight training program.

t. Under normal circumstances, the NSPM establishes a date for the initial or upgrade evaluation within ten (10) working days after determining that a complete QTG is acceptable. Unusual circumstances may warrant establishing an evaluation date before this determination is made. A sponsor may schedule an evaluation date as early as 6 months in advance. However, there may be a delay of 45 days or more in rescheduling and completing the evaluation if the sponsor is unable to meet the scheduled date. See Attachment 4 of this appendix, Figure A4A, Sample Request for Initial, Upgrade, or Reinstatement Evaluation.

u. The numbering system used for objective test results in the QTG should closely follow the numbering system set out in Attachment 2 of this appendix, FFS Objective Tests, Table A2A.

v. Contact the NSPM or visit the NSPM Web site for additional information regarding the preferred qualifications of pilots used to meet the requirements of § 60.15(d).

w. Examples of the exclusions for which the FFS might not have been subjectively tested by the sponsor or the NSPM and for which qualification might not be sought or granted, as described in § 60.15(g)(6), include windshear training and circling approaches.

End Information

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12. Additional Qualifications for a Currently Qualified FFS (§ 60.16)

Begin Information

No additional regulatory or informational material applies to § 60.16, Additional Qualifications for a Currently Qualified FFS.

End Information

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13. Previously Qualified FFSs (§ 60.17)

Begin QPS Requirements

a. In instances where a sponsor plans to remove an FFS from active status for a period of less than two years, the following procedures apply:

(1) The NSPM must be notified in writing and the notification must include an estimate of the period that the FFS will be inactive;

(2) Continuing Qualification evaluations will not be scheduled during the inactive period;

(3) The NSPM will remove the FFS from the list of qualified FSTDs on a mutually established date not later than the date on which the first missed continuing qualification evaluation would have been scheduled;

(4) Before the FFS is restored to qualified status, it must be evaluated by the NSPM. 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.

(5) The sponsor must notify the NSPM of any changes to the original scheduled time out of service;

b. Simulators qualified prior to May 30, 2008, are not required to meet the general simulation requirements, the objective test requirements or the subjective test requirements of attachments 1, 2, and 3 of this appendix as long as the simulator continues to meet the test requirements contained in the MQTG developed under the original qualification basis.

c. After May 30, 2009, each visual scene or airport model beyond the minimum required for the FFS qualification level that is installed in and available for use in a qualified FFS must meet the requirements described in attachment 3 of this appendix.

d. Simulators qualified prior to May 30, 2008, may be updated. If an evaluation is deemed appropriate or necessary by the NSPM after such an update, the evaluation will not require an evaluation to standards beyond those against which the simulator was originally qualified.

End QPS Requirements

Begin Information

e. Other certificate holders or persons desiring to use an FFS may contract with FFS sponsors to use FFSs previously qualified at a particular level for an airplane type and approved for use within an FAA-approved flight training program. Such FFSs are not required to undergo an additional qualification process, except as described in § 60.16.

f. Each FFS user must obtain approval from the appropriate TPAA to use any FFS in an FAA-approved flight training program.

g. The intent of the requirement listed in § 60.17(b), for each FFS to have a SOQ within 6 years, is to have the availability of that statement (including the configuration list and the limitations to authorizations) to provide a complete picture of the FFS inventory regulated by the FAA. The issuance of the statement will not require any additional evaluation or require any adjustment to the evaluation basis for the FFS.

h. Downgrading of an FFS is a permanent change in qualification level and will necessitate the issuance of a revised SOQ to reflect the revised qualification level, as appropriate. If a temporary restriction is placed on an FFS because of a missing, malfunctioning, or inoperative component or on-going repairs, the restriction is not a permanent change in qualification level. Instead, the restriction is temporary and is removed when the reason for the restriction has been resolved.

i. The NSPM will determine the evaluation criteria for an FFS that has been removed from active status. The criteria will be based on the number of continuing qualification evaluations and quarterly inspections missed during the period of inactivity. For example, if the FFS were out of service for a 1 year period, it would be necessary to complete the entire QTG, since all of the quarterly evaluations would have been missed. The NSPM will also consider how the FFS was stored, whether parts were removed from the FFS and whether the FFS was disassembled.

j. The FFS will normally be requalified using the FAA-approved MQTG and the criteria that was in effect prior to its removal from qualification. However, inactive periods of 2 years or more will require requalification under the standards in effect and current at the time of requalification.

End Information

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14. Inspection, Continuing Qualification Evaluation, and Maintenance Requirements (§ 60.19)

Begin QPS Requirements

a. 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 NSPM.

b. The description of the functional preflight check must be contained in the sponsor's QMS.

c. Record ''functional preflight'' in the FFS discrepancy log book or other acceptable location, including any item found to be missing, malfunctioning, or inoperative.

d. During the continuing qualification evaluation conducted by the NSPM, the sponsor must also provide a person knowledgeable about the operation of the aircraft and the operation of the FFS.

e. The NSPM will conduct continuing qualification evaluations every 12 months unless:

(1) The NSPM becomes aware of discrepancies or performance problems with the device that warrants more frequent evaluations; or

(2) The sponsor implements a QMS that justifies less frequent evaluations. However, in no case shall the frequency of a continuing qualification evaluation exceed 36 months.

End QPS Requirements

Begin Information

f. The sponsor's test sequence and the content of each quarterly inspection required in § 60.19(a)(1) should include a balance and a mix from the objective test requirement areas listed as follows:

(1) Performance.

(2) Handling qualities.

(3) Motion system (where appropriate).

(4) Visual system (where appropriate).

(5) Sound system (where appropriate).

(6) Other FFS systems.

g. If the NSP 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.

h. The continuing qualification evaluations, described in § 60.19(b), will normally require 4 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:

(1) Review of the results of the quarterly inspections conducted by the sponsor since the last scheduled continuing qualification evaluation.

(2) 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 (⅓) of the allotted FFS time.

(3) A subjective evaluation of the FFS to perform a representative sampling of the tasks set out in attachment 3 of this appendix. This portion of the evaluation should take approximately two-thirds (⅔) of the allotted FFS time.

(4) 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 airplane systems. This examination is normally accomplished simultaneously with the subjective evaluation requirements.

End Information

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15. Logging FFSs Discrepancies (§ 60.20)

Begin Information

No additional regulatory or informational material applies to § 60.20. Logging FFS Discrepancies.

End Information

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16. Interim Qualification of FFSs for New Airplane Types or Models (§ 60.21)

Begin Information

No additional regulatory or informational material applies to § 60.21, Interim Qualification of FFSs for New Airplane Types or Models.

End Information

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17. Modifications to FFSs (§ 60.23)

Begin QPS Requirements

a. The notification described in § 60.23(c)(2) must include a complete description of the planned modification, with a description of the operational and engineering effect the proposed modification will have on the operation of the FFS and the results that are expected with the modification incorporated.

b. Prior to using the modified FFS:

(1) All the applicable objective tests completed with the modification incorporated, including any necessary updates to the MQTG (e.g., accomplishment of FSTD Directives) must be acceptable to the NSPM; and

(2) The sponsor must provide the NSPM with a statement signed by the MR that the factors listed in § 60.15(b) are addressed by the appropriate personnel as described in that section.

End QPS Requirements

Begin Information

c. FSTD Directives are considered modifications of an FFS. See Attachment 4 of this appendix for a sample index of effective FSTD Directives. See Attachment 6 of this appendix for a list of all effective FSTD Directives applicable to Airplane FFSs.

d. Examples of MQTG changes that do not require FAA notification under § 60.23(a) are limited to repagination, correction of typographical or grammatical errors, typesetting, or presenting additional parameters on existing test result formats. All changes regardless of nature should be documented in the MQTG revision history.

End Information

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18. Operation With Missing, Malfunctioning, or Inoperative Components (§ 60.25)

Begin Information

a. The sponsor's responsibility with respect to § 60.25(a) is satisfied when the sponsor fairly and accurately advises the user of the current status of an FFS, including any missing, malfunctioning, or inoperative (MMI) component(s).

b. It is the responsibility of the instructor, check airman, or representative of the administrator conducting training, testing, or checking to exercise reasonable and prudent judgment to determine if any MMI component is necessary for the satisfactory completion of a specific maneuver, procedure, or task.

c. If the 29th or 30th day of the 30-day period described in § 60.25(b) is on a Saturday, a Sunday, or a holiday, the FAA will extend the deadline until the next business day.

d. In accordance with the authorization described in § 60.25(b), the sponsor may develop a discrepancy prioritizing system to accomplish repairs based on the level of impact on the capability of the FFS. Repairs having a larger impact on FFS capability to provide the required training, evaluation, or flight experience will have a higher priority for repair or replacement.

End Information

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19. Automatic Loss of Qualification and Procedures for Restoration of Qualification (§ 60.27)

Begin Information

If the sponsor provides a plan for how the FFS will be maintained during its out-of-service period (e.g., periodic exercise of mechanical, hydraulic, and electrical systems; routine replacement of hydraulic fluid; control of the environmental factors in which the FFS is to be maintained) there is a greater likelihood that the NSPM will be able to determine the amount of testing required for requalification.

End Information

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20. Other Losses of Qualification and Procedures for Restoration of Qualification (§ 60.29)

Begin Information

If the sponsor provides a plan for how the FFS will be maintained during its out-of-service period (e.g., periodic exercise of mechanical, hydraulic, and electrical systems; routine replacement of hydraulic fluid; control of the environmental factors in which the FFS is to be maintained) there is a greater likelihood that the NSPM will be able to determine the amount of testing required for requalification.

End Information

21. Recordkeeping and Reporting (§ 60.31)

Begin QPS Requirements

a. FFS modifications can include hardware or software changes. For FFS modifications involving software programming changes, the record required by § 60.31(a)(2) must consist of the name of the aircraft system software, aerodynamic model, or engine model change, the date of the change, a summary of the change, and the reason for the change.

b. If a coded form for record keeping is used, it must provide for the preservation and retrieval of information with appropriate security or controls to prevent the inappropriate alteration of such records after the fact.

End QPS Requirements

22. Applications, Logbooks, Reports, and Records: Fraud, Falsification, or Incorrect Statements (§ 60.33)

Begin Information

No additional regulatory or informational material applies to § 60.33, Applications, Logbooks, Reports, and Records: Fraud, Falsification, or Incorrect Statements.

23. Specific FFS Compliance Requirements (§ 60.35)

No additional regulatory or informational material applies to § 60.35, Specific FFS Compliance Requirements.

24. [Reserved]

25. FFS Qualification on the Basis of a Bilateral Aviation Safety Agreement (BASA) (§ 60.37)

No additional regulatory or informational material applies to § 60.37, FFS Qualification on the Basis of a Bilateral Aviation Safety Agreement (BASA).

End Information

Attachment 1 to Appendix A to Part 60—General Simulator Requirements

Begin QPS Requirements

1. Requirements

a. Certain requirements included in this appendix must be supported with an SOC as defined in Appendix F, which may include objective and subjective tests. The requirements for SOCs are indicated in the ''General Simulator Requirements'' column in Table A1A of this appendix.

b. Table A1A describes the requirements for the indicated level of FFS. Many devices include operational systems or functions that exceed the requirements outlined in this section. However, all systems will be tested and evaluated in accordance with this appendix to ensure proper operation.

End QPS Requirements

Begin Information

2. Discussion

a. This attachment describes the general simulator requirements for qualifying an airplane FFS. The sponsor should also consult the objective tests in Attachment 2 of this appendix and the examination of functions and subjective tests listed in Attachment 3 of this appendix to determine the complete requirements for a specific level simulator.

b. The material contained in this attachment is divided into the following categories:

(1) General flight deck configuration.

(2) Simulator programming.

(3) Equipment operation.

(4) Equipment and facilities for instructor/evaluator functions.

(5) Motion system.

(6) Visual system.

(7) Sound system.

c. Table A1A provides the standards for the General Simulator Requirements.

d. Table A1B 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.

e. Table A1C provides the functions that an instructor/check airman must be able to control in the simulator.

f. 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.

End Information

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	**Simulator Levels**				**INFORMATION**
Entry Number	**General Simulator Requirements**	**A**	**B**	**C**	**D**	**Notes**
1.	**FEATURE GENERAL REQUIREMENT** **FLIGHT DECK LAYOUT & STRUCTURE**					
1.S	**An enclosed full scale replica of the airplane cockpit/flight deck, which will have fully functional controls, instruments and switches to support the approved use.** **Anything not required to be accessed by the flight crew during normal, abnormal, emergency and, where applicable, non-normal operations does not need to be functional.**	**X**	**X**	**X**	**X**	
1.R	**Reserved**					
1.G	**Reserved**					
	FEATURE TECHNICAL REQUIREMENT COCKPIT/FLIGHT DECK LAYOUT & STRUCTURE					
1.1	COCKPIT/FLIGHT DECK STRUCTURE					
1.1.S.a	An enclosed, full scale replica of the cockpit/flight deck of the airplane being simulated.	**X**	**X**	**X**	**X**	
1.1.S.b	Reserved					
1.1.S.c	An enclosed, full scale replica of the cockpit/flight deck of the airplane being simulated including all: structure and panels; primary and secondary flight controls; engine and propeller controls, as applicable; equipment and systems with associated controls and observable indicators; circuit breakers; flight instruments; navigation, communications and similar use equipment; caution and warning systems and emergency equipment. The tactile feel, technique, effort, travel and direction required to manipulate the preceding, as applicable, must replicate those in the airplane. As applicable, equipment for operation of the cockpit/flight deck windows must be included but the actual windows need not be operable. Additional required flight crew member duty stations and those bulkheads aft of the pilots' seats containing items such as switches, circuit breakers, supplementary radio panels, etc., to which the flight crew may require access during any event after pre-flight cockpit/flight deck preparation is complete, are also considered part of the cockpit/flight deck and must replicate the airplane. *Note.— The cockpit/flight deck, for flight simulation purposes, consists of all that space forward of a cross section of the fuselage at the most extreme aft setting of the flight crew members' seats or if applicable, to that cross section immediately aft of additional flight crew member seats and/or required bulkheads.*	**X**	**X**	**X**	**X**	Airplane observer seats are not considered to be additional flight crew member duty stations and may be omitted. The use of electronically displayed images with physical overlay or masking for FSTD instruments and/or instrument panels is acceptable provided: – all instruments and instrument panel layouts are dimensionally correct with differences, if any, being imperceptible to the pilot; – instruments replicate those of the airplane including full instrument functionality and embedded logic; – instruments displayed are free of quantization (stepping); – instrument display characteristics replicate those of the airplane including: resolution, colors, luminance, brightness, fonts, fill patterns, line styles and

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
						symbology; – overlay or masking, including bezels and bugs, as applicable, replicates the airplane panel(s); – instrument controls and switches replicate and operate with the same technique, effort, travel and in the same direction as those in the airplane; – 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; – as applicable, instruments should have faceplates that replicate those in the airplane; and Level D only; • the display image of any three dimensional instrument, such as an electro-mechanical instrument, should appear to have the same three dimensional depth as the replicated instrument. The appearance of the simulated instrument, when viewed from any angle, should replicate that of the actual 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.
1.1.R	Reserved					
1.1.G	Reserved					
1.2	SEATING					
1.2.1.S	Flight crew member seats must replicate those in the airplane being simulated.	X	X	X	X	
1.2.1.R	Reserved					
1.2.1.G	Reserved					

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
1.2.2.S.a	In addition to the flight crew member seats, there must be one instructor station seat and two suitable seats for an observer and an authority inspector. The location of at least one of these seats must provide an adequate view of the pilots' panels and forward windows.	X	X	X	X	The NSPM may consider options to this requirement based on unique cockpit/flight deck configurations. The seats need not represent those found in the airplane but should be adequately secured and fitted with positive restraint devices of sufficient integrity to safely restrain the occupant during any known or predicted motion system excursion. Both seats should have adequate lighting to permit note taking and a system to permit selective monitoring of all flight crew member and instructor communications. Both seats should be of adequate comfort for the occupant to remain seated for a two-hour training session.
1.2.2.S.b	Reserved					
1.2.2.R	Reserved					
1.2.2.G	Reserved					
1.3	COCKPIT/FLIGHT DECK LIGHTING					
1.3.S	Cockpit/flight deck lighting must replicate that in the airplane	X	X	X	X	
1.3.R	Reserved					
1.3.G	Reserved					
2.	**FEATURE GENERAL REQUIREMENT FLIGHT MODEL**					
2.S	**Aerodynamic and engine modeling for all combinations of drag and thrust, including the effects of change in airplane attitude, sideslip, altitude, temperature, gross mass, center of gravity location and configuration to support the approved use. Must address ground effect, mach effect, aeroelastic representations, non-linearities due to sideslip, effects of airframe icing, forward and reverse dynamic thrust effect on control surfaces. Realistic airplane mass properties, including mass, center of gravity and moments of inertia as a function of payload and fuel loading must be implemented. Extended envelope modeling to the extent necessary for full stall training and upset recovery training.**			X	X	
2.S1	**Aerodynamic and engine modeling for all combinations of drag and thrust, including the effects of change in airplane attitude, sideslip, altitude, temperature, gross mass, center of gravity location and configuration to support the approved use. Realistic airplane mass properties, including mass, center of gravity and moments of inertia as a function of payload and fuel loading must be implemented.**	X	X			

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
2.R	**Reserved**					
2.G	**Reserved**					
	FEATURE TECHNICAL REQUIREMENT FLIGHT MODEL					
2.1	FLIGHT DYNAMICS MODEL					
2.1.1.S,S1	Flight dynamics model that accounts for various combinations of drag and thrust normally encountered in flight supported by type-specific flight test data, including the effect of change in airplane attitude, sideslip, thrust, drag, altitude, temperature, gross mass, moments of inertia, center of gravity location and configuration to support the approved use.	X	X	X	X	
2.1.2.S	Aerodynamic modeling that includes, for airplanes issued an original type certificate after 30 June 1980, Mach effect, normal and reverse dynamic thrust effect on control surfaces, aeroelastic effect and representations of non-linearities due to side-slip based on airplane flight test data provided by the airplane manufacturer. SOC required.			X	X	Mach effect, aeroelastic representations and non-linearities due to side-slip are normally included in the flight simulator aerodynamic model. The SOC should address each of these items. Separate tests for thrust effects and an SOC are required.
2.1.3.S	Aerodynamic modeling to include ground effect derived from type-specific flight test data. For example: round-out, flare and touchdown. This requires data on lift, drag, pitching moment, trim and power in ground effect. SOC required.			X	X	See Attachment 2, paragraph 5 and test 2.f for further information on ground effect.
2.1.4.S,S1	Aerodynamic modeling for the effects of reverse thrust on directional control.		X	X	X	Tests required. See Attachment 2, tests 2.e.8 and 2.e.9 (directional control).
2.1.5.S	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 airplane 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 autoflight 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 that are representative of the simulated aircraft's performance degradation in a typical in-flight icing encounter. SOC and tests required. See objective testing requirements.			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 airplanes 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 Attachment 7 of this Appendix for further guidance material.
2.1.6.S	Upset Recognition and Recovery. Aerodynamics Evaluation: The simulator must be evaluated for specific upset recovery maneuvers for the purpose of determining that the combination of angle of attack and sideslip does not exceed the range of flight test validated			X	X	This section generally applies to the qualification of airplane upset recovery training maneuvers that may exceed one or

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
	data or wind tunnel/analytical data while performing the recovery maneuver. The following minimum set of upset recovery maneuvers must be evaluated in this manner and made available to the instructor/evaluator. Other upset recovery scenarios as developed by the FSTD sponsor must be evaluated in the same manner: ▪ A nose-high, wings level aircraft upset. ▪ A nose-low, wings level aircraft upset. ▪ A high bank angle aircraft upset. Upset Scenarios: Selectable dynamic airplane upsets must provide guidance to the instructor concerning the method utilized to drive the FSTD into an upset condition including any malfunction or degradation in the FSTD's functionality required to initiate the upset. To avoid a potential negative transfer of training, the intentional degradation of simulator functionality (such as degrading flight control effectiveness) to drive an airplane upset is generally not acceptable unless used purely as a tool for repositioning the FSTD with the pilot out of the loop. Aircraft system malfunctions or other malfunctions may be utilized to stimulate an aircraft upset, however the effects of these malfunctions must be representative of the aircraft and, where possible, supported by data. IOS selectable dynamic airplane upsets that simulate external events (such as a wake vortex encounter) that require pilot intervention to avoid and/or recover from an upset condition must be realistic and based upon relevant data sources. Instructor Operating System (IOS): The simulator must have a feedback mechanism in place to notify the instructor/evaluator when the simulator's validated aerodynamic envelope (in terms of angle of attack and sideslip) and aircraft operating limits have been exceeded during an upset recovery training task. To allow for controlled training of upset prevention and recovery maneuvers, the following features as listed below, or equivalent, must be provided: o A means to playback audio and video o A means to record and playback pertinent parameters including: ▪ Aircraft weight and center of gravity ▪ Attitudes, airspeed, altitude, angle of attack, sideslip, and g-loading. ▪ Primary flight control position and force ▪ Secondary flight controls: stabilizer/trim, speed brake, flaps, and gear positions ▪ Warnings (audible and visual), stick shaker/pusher trigger and limits (CI-max) The data recording may be in time history or graphical format. Specific Features and/or malfunctions for use in upset prevention and recovery training are not prescribed. The operator may use appropriate available features/malfunctions to ensure a minimum are available to allow for the following: o Selection of features or malfunctions specifically tailored to allow for the training of crew "awareness" of a potential upset condition must be provided. o Selection of features or malfunctions specifically tailored to allow for the training of crew "recognition" of a developing upset condition must be provided. o Selection of features or malfunctions specifically tailored to allow for the training of crew "recovery" of a developed upset condition must be provided. These features/malfunctions must be evaluated in conjunction with the aerodynamic assessment described above. Statement of Compliance (SOC):					more of the following conditions: ▪ Pitch attitude greater than 25 degrees, nose up ▪ Pitch attitude greater than 10 degrees, nose down ▪ Bank angle greater than 45 degrees ▪ Flight at airspeeds inappropriate for conditions. Airplane upsets should be based primarily upon the criteria defined in the Airplane Upset Recovery Training Aid (revision 2). FSTDs used to conduct upset recovery maneuvers at angles of attack above the stall warning system activation must meet the requirements for high angle of attack modeling as described in section 2.1.7.S. Special consideration should be given to the motion system response during upset prevention and recovery maneuvers. Notwithstanding the limitations of simulator motion, specific emphasis should be placed on tuning out motion system responses and effects that have the potential for the transfer of negative training. See Attachment 7 of this Appendix for further guidance material.

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	**Simulator Levels**				**INFORMATION**
Entry Number	**General Simulator Requirements**	**A**	**B**	**C**	**D**	**Notes**
	• An SOC is required that defines the source data used to construct the flight test and wind tunnel/analytical envelope. • The SOC must verify that each upset prevention and recovery feature programmed at the instructor station and the associated training maneuver has been evaluated by a suitably qualified pilot using methods described in this section. The statement must confirm that the recovery maneuver can be performed such that the FSTD does not exceed the flight test and wind tunnel envelope described above, or when exceeded, that it is within the realm of confidence in the simulation accuracy. • The SOC must confirm the source of data used for the aircraft operating limits which are used to provide the instructor indications or warnings on approaching or exceeding these limits.					
2.1.7.S	High Angle of Attack Modeling The simulator must include aerodynamic modeling for high angle of attack maneuvers to at least ten degrees beyond the stall angle of attack or as required to execute a recovery from a fully stalled flight condition. The following stall maneuvers must be evaluated for qualification: ▪ 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) ▪ Aircraft configurations of second segment climb, high altitude cruise (near performance limited condition), and approach or landing. Tests required For stick pusher equipped aircraft, 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. 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 with acceptable supporting documentation and/or direct experience of the stall characteristics of the aircraft being simulated. See Attachment 7 of this Appendix for detailed requirements. For aircraft equipped with a stall identification system (e.g. stick pusher) that is required for aircraft dispatch, objective testing will only be required through activation of the stall identification system to recovery to a normal flight attitude. The aerodynamic model must be programmed and evaluated using the best available data to demonstrate the expected aircraft behavior should the stall identification system be overridden or disabled as required for training. Specific FSTD limitations due to data availability must be identified to the NSPM and indicated on the Statement of Qualification. See objective testing requirements for details.			**X**	**X**	See Attachment 7 of this Appendix for further guidance material. 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. The use of an "alpha/beta" validation envelope that defines the range of stall model validation is encouraged (see section 2.1.6.S.on upset recognition and recovery).
2.1.R	Reserved					
2.1.G	Reserved					
2.2	MASS PROPERTIES					
2.2.S	Type specific implementation of airplane mass properties, including mass, center of gravity and moments of inertia as a function of payload and fuel loading. The effects of pitch attitude and of fuel slosh on the aircraft center of gravity must be simulated.	**X**	**X**	**X**	**X**	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.

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
	SOC required.					The SOC should include the effects of fuel slosh on center of gravity.
2.2.R	Reserved					
2.2.G	Reserved					
3.	**FEATURE GENERAL REQUIREMENT** **GROUND REACTION AND HANDLING CHARACTERISTICS**					
3.S	**Represents ground reaction and handling characteristics of the airplane during surface operations to support the approved use.** **Brake and tire failure dynamics (including antiskid) and decreased brake efficiency must be specific to the aircraft simulated. Stopping and directional control forces must be representative for all environmental runway conditions.**			**X**	**X**	
3.R	**Represents ground reaction and handling, airplane-like, derived from and appropriate to class.**		**X**			
3.G	**Represents ground reaction, airplane-like, derived from and appropriate to class.** **Simple airplane like ground reactions, appropriate to the airplane mass and geometry.**	**X**				
	FEATURE TECHNICAL REQUIREMENT GROUND REACTION AND HANDLING CHARACTERISTICS					
3.1	GROUND REACTION AND HANDLING CHARACTERISTICS					
3.1.S	Airplane type specific ground handling simulation to include: (1) Ground reaction. Reaction of the airplane upon contact with the runway during take-off, landing and ground operations to include strut deflections, tire friction, side forces, environmental effects and other appropriate data, such as weight and speed, necessary to identify the flight condition and configuration. Ground reaction modeling must simulate the effects of a bounced or skipped landing (to include indications of a tail strike or nosewheel exceedances) as appropriate for the simulated aircraft and conditions; and (2) Ground handling characteristics. Steering inputs to include crosswind, gusting crosswind, braking, thrust reversing, deceleration and turning radius. Ground handling must react properly to crosswind and gusting crosswind up to the aircraft's maximum demonstrated crosswind component. SOC required.			**X**	**X**	Tests required.
3.1.R	Representative airplane ground handling simulation to include: (1) Ground reaction. Reaction of the airplane upon contact with the runway during take-off, landing and ground operations to include strut deflections, tire friction, side forces and other appropriate data, such as weight and speed, necessary to identify the flight condition and configuration; and (2) Ground handling characteristics. Steering inputs to include crosswind, gusting crosswind, braking, thrust reversing, deceleration and turning radius. Ground handling must react properly to crosswind and gusting crosswind up to the aircraft's maximum demonstrated crosswind component.		**X**			Tests required.

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
	SOC required.					
3.1.G	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				
3.2	RUNWAY CONDITIONS					
3.2.S	Stopping and directional control forces for at least the following runway conditions based on airplane related data: (1) dry; (2) wet; (3) icy; (4) patchy wet; (5) patchy icy; and (6) wet on rubber residue in touchdown zone. SOC required.			X	X	Objective tests required for (1), (2) and (3). See Attachment 2, tests 1.e (stopping). Subjective tests for (4), (5) and (6). See Attachment 3.
3.2.R	Stopping and directional control forces must be representative for at least the following runway conditions based on airplane related data: (1) dry; and (2) wet.		X			
3.2.G	Stopping and directional control forces for dry runway conditions.	X				
3.3	BRAKE AND TIRE FAILURES					
3.3.S	Brake and tire failure dynamics (including anti-skid) and decreased braking efficiency due to brake temperatures. SOC required.			X	X	Subjective tests required for decreased braking efficiency due to brake temperature, if applicable.
3.3.R	Reserved					
3.3.G	Reserved					
4.	**FEATURE GENERAL REQUIREMENT AIRPLANE SYSTEMS (ATA)**					
4.S	**Airplane systems must be replicated with sufficient functionality for flight crew operation to support the approved use. System functionality must enable all normal, abnormal, and emergency operating procedures to be accomplished to include communications, navigation, caution and warning equipment corresponding to the airplane. Circuit breakers required for operations must be functional.**	X	X	X	X	
4.R	**Reserved**					

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
4.G	**Reserved**					
	FEATURE TECHNICAL REQUIREMENT AIRPLANE SYSTEMS (ATA)					
4.1	NORMAL, ABNORMAL AND EMERGENCY SYSTEMS OPERATION					
4.1.S	All airplane systems represented in the FSTD must simulate the specific airplane type system operation including system interdependencies, both on the ground and in flight. Systems must be operative to the extent that all normal, abnormal and emergency operating procedures can be accomplished.	X	X	X	X	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. Once activated, proper systems operation should result from system management by the crew member and not require any further input from the instructor's controls.
4.1.R	Reserved					
4.1.G	Reserved					
4.2	CIRCUIT BREAKERS					
4.2.S	Circuit breakers that affect procedures and/or result in observable cockpit/flight deck indications must be functionally accurate.	X	X	X	X	
4.2.R	Reserved					
4.2.G	Reserved					
4.3	INSTRUMENT INDICATIONS					
4.3.S	All relevant instrument indications involved in the simulation of the airplane must 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.
4.3.R	Reserved					
4.3.G	N/A.					
4.4	COMMUNICATIONS, NAVIGATION AND CAUTION AND WARNING SYSTEMS					
4.4.S	Communications, navigation, and caution and warning equipment corresponding to that installed in a specific airplane type must operate within the tolerances prescribed for the applicable airborne equipment.	X	X	X	X	
4.4.R	Reserved					
4.4.G	N/A.					
4.5	ANTI-ICING SYSTEMS					
4.5.S	Operation of anti-icing systems corresponding to those installed in the specific airplane type must operate with appropriate effects upon ice formation on airframe, engines and instrument sensors.	X	X	X	X	
4.5.R	Reserved					
4.5.G	N/A.					
5.	**FEATURE GENERAL REQUIREMENT** **FLIGHT CONTROLS AND FORCES**					

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
5.S	**Control forces and control travel must correspond to that of the airplane to support the approved use.** **Control displacement must generate the same effect as the airplane under the same flight conditions.** **Control feel dynamics must replicate the airplane simulated.**			X	X	
5.S1	**Control forces and control travel must correspond to that of the airplane to support the approved use.** **Control displacement must generate the same effect as the airplane under the same flight conditions.**	X	X			
5.R	**Reserved**					
5.R1	**Reserved**					
5.G	**Reserved**					
	FEATURE TECHNICAL REQUIREMENT FLIGHT CONTROLS AND FORCES					
5.1	CONTROL FORCES AND TRAVEL					Testing of position versus force is not applicable if forces are generated solely by use of airplane hardware in the FSTD.
5.1.S, S1	Control forces, control travel and surface position must correspond to that of the type-specific airplane being replicated. Control travel, forces and surfaces must react in the same manner as in the airplane under the same flight and system conditions.	X	X	X	X	Active Force feedback required if appropriate to the airplane installation.
5.1.R	Reserved					
5.1.R1	Reserved					
5.1.G	Reserved					
5.2	CONTROL FEEL DYNAMICS					
5.2.S	Control feel dynamics must replicate the airplane simulated.			X	X	See Attachment 2, paragraph 4 for a discussion of acceptable methods of validating control dynamics. Tests required. See Attachment 2, tests 2.b.1 through 2.b.3 (dynamic control checks).
5.2.S1,R,G	N/A.					
5.3	CONTROL SYSTEM OPERATION					
5.3.S, S1	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	X	X	
5.3.R, R1	Reserved					
5.3.G	Reserved					
6.	**FEATURE GENERAL REQUIREMENT** **SOUND CUES**					
6.S	**N/A.**					
6.R	**Significant sounds perceptible to the flight crew during flight operations to support the approved use.**				X	Objective tests required. See Attachment 2,

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
	Comparable engine, airframe and environmental sounds. **The volume control must have an indication of sound level setting.**					Section 5.
6.R1	**Significant sounds perceptible to the flight crew during flight operations to support the approved use.** **Comparable engine, airframe and environmental sounds.** **The volume control must have an indication of sound level setting.**			**X**		
6.R2	**Significant sounds perceptible to the flight crew during flight operations to support the approved use.** **Comparable engine and airframe sounds.** **The volume control must have an indication of sound level setting.**	**X**	**X**			
6.G	**Reserved**					
	FEATURE TECHNICAL REQUIREMENT SOUND CUES					
6.1	SOUND SYSTEM					
6.1.R	Significant cockpit/flight deck sounds during normal and abnormal operations corresponding to those of the airplane, including engine and airframe sounds as well as those which result from pilot or instructor-induced actions. SOC required. Tests required				**X**	See Attachment 2.
6.1.R1, R2	Significant cockpit/flight deck sounds during normal and abnormal operations corresponding to those of the airplane, including engine and airframe sounds as well as those which result from pilot or instructor-induced actions. SOC required	**X**	**X**	**X**		
6.1.G	Reserved					
6.2	CRASH SOUNDS					
6.2.R, R1	The sound of a crash when the simulated airplane exceeds limitations.			**X**	**X**	
6.2.G	Reserved					
6.3	ENVIRONMENTAL SOUNDS					
6.3.R, R1	Significant environmental sounds must be coordinated with the simulated weather.			**X**	**X**	
6.3.R2	Environmental sounds are not required. If environmental sounds are present, they must be coordinated with the simulated weather.	**X**	**X**			
6.3.G	Reserved					
6.4	SOUND VOLUME					
6.4.R	The volume control must have an indication of sound level setting which meets all qualification requirements. Full volume must correspond to actual volume levels in the approved data set. When full volume is not selected, an				**X**	The abnormal setting should consist of an annunciation on a main IOS page which is always visible to the instructor.

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
	indication of abnormal setting must be provided to the instructor.					
6.4.R1, R2	The volume control must have an indication of sound level setting which meets all qualification requirements. Full volume must correspond to actual volume level agreed at the initial evaluation. When full volume is not selected, an indication of abnormal setting must be provided to the instructor.	X	X	X		
6.4.G	Reserved					
6.5	SOUND DIRECTIONALITY					
6.5.R, R1	Sound must be directionally representative. SOC required.			X	X	
6.5.R2	Sound not required to be directional.	X	X			
7.	**FEATURE GENERAL REQUIREMENT** **VISUAL DISPLAY CUE**					
7.S	**Continuous field of view with infinity perspective and textured representation of all ambient conditions for each pilot, to support the approved use.** **Horizontal and vertical field of view to support the most demanding maneuvers requiring a continuous view of the runway.** **A minimum of 200° horizontal and 40° vertical field of view.**			X	X	
7.S1	**Continuous field of view with infinity perspective and textured representation of all ambient conditions for each pilot, to support the approved use.** **Horizontal and vertical field of view to support the most demanding maneuvers requiring a continuous view of the runway.** **A minimum of 45° horizontal and 30° vertical field of view.**	X	X			
7.R	**Reserved**					
7.G	**Reserved**					
	FEATURE TECHNICAL REQUIREMENT VISUAL CUES					
7.1	DISPLAY					
7.1.1	DISPLAY GEOMETRY AND FIELD OF VIEW					
7.1.1.S	Continuous, cross-cockpit, collimated visual. Display providing each pilot with a minimum 200° horizontal and 40° vertical field of view. The system must be free from optical discontinuities and artifacts that create non-realistic cues.			X	X	See Attachment 2 – Test 4.a.1. An SOC is acceptable in place of this test. *Note. Where the training task includes circling approaches with the landing on the reciprocal runway, a visual field of view in excess of 200° horizontal and 40° vertical will likely be required.*

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
7.1.1.S1	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 system must be free from optical discontinuities and artifacts that create non-realistic cues. An SOC is required and must explain the system geometry measurements including system linearity and field-of-view.	X	X			See Attachment 2 – Test 4.a.1. Additional field-of-view capability may be added at the sponsor's discretion provided the minimum fields of view are retained.
7.1.1.R	Reserved					
7.1.1.G	Reserved					
7.1.2	DISPLAY RESOLUTION					
7.1.2.S	Display resolution demonstrated by a test pattern of objects shown to occupy a visual angle of not greater than 2 arc minutes in the visual display used on a scene from the pilot's eye point. SOC required containing calculations confirming resolution.			X	X	See Attachment 2 (surface resolution) – Test 4.a.3.
7.1.2.R	Reserved					
7.1.2.G	Reserved					
7.1.3	LIGHT-POINT SIZE					
7.1.3.S	Light-point size — not greater than 5 arc minutes. SOC required confirming test pattern represents lights used for airport lighting.			X	X	See Attachment 2 – Test 4.a.4.
7.1.3.R	Reserved					
7.1.3.G	Reserved					
7.1.4	DISPLAY CONTRAST RATIO					
7.1.4.S	Display Contrast ratio — not less than 5:1.			X	X	See Attachment 2 (surface contrast ratio) – Test 4.a.5.
7.1.4.R	Reserved					
7.1.4.G	Reserved					
7.1.5	LIGHT-POINT CONTRAST RATIO					
7.1.5.S	Light-point contrast ratio — not less than 25:1.			X	X	See Attachment 2 (light-point contrast ratio) – Test 4.a.6.
7.1.5.S1	Light-point contrast ratio — not less than 10:1.	X	X			See Attachment 2 (light-point contrast ratio) – Test 4.a.6.
7.1.5.R	Reserved					
7.1.5.G	Reserved					
7.1.6	LIGHT-POINT BRIGHTNESS					
7.1.6.S	Light-point brightness – not less than 30 cd/m^2 (8.8 foot-lamberts).			X	X	See Attachment 2, (light-point brightness) – Test 4.a.7.
7.1.6.R	Reserved					
7.1.6.G	Reserved					
7.1.7	DISPLAY BRIGHTNESS					

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
7.1.7.S	Display brightness must be demonstrated using a raster drawn test pattern. The surface brightness must not be less than 20 cd/m^2 (5.8 foot-lamberts).			X	X	See Attachment 2 – Test 4.a.8.
7.1.7.R	Reserved					
7.1.7.G	Reserved					
7.1.8	BLACK LEVEL AND SEQUENTIAL CONTRAST (**Light valve systems only**)					
7.1.8.S, S1	The black level and sequential contrast need to be measured to determine it is sufficient for training in all times of day.	X	X	X	X	A test is generally only required for light valve projectors. See Attachment 2 – Test 4.a.9.
7.1.8.R	Reserved					
7.1.8.G	Reserved					
7.1.9	MOTION BLUR (**Light valve systems only**)					
7.1.9.S, S1	Tests are required to determine the amount of motion blur that is typical of certain types of display equipment. A test must be provided that demonstrates the amount of blurring at a pre-defined rate of movement across the image.	X	X	X	X	A test is generally only required for light valve projectors. See Attachment 2 – Test 4.a.10.
7.1.9.R	Reserved					
7.1.9.G	Reserved					
7.1.10	SPECKLE TEST (**Laser systems only**)					
7.1.10.S, S1	A test is required to determine that the speckle typical of laser-based displays is below a distracting level.	X	X	X	X	A test is generally only required for laser projectors. See Attachment 2 – Test 4.a.11.
7.1.10.R	Reserved					
7.1.10.G	Reserved					
7.2	ADDITIONAL DISPLAY SYSTEMS					
7.2.1	HEAD-UP DISPLAY (where fitted)					
7.2.1.S, S1	The system must be shown to perform its intended function for each operation and phase of flight. An active display (repeater) of all parameters displayed on the pilot's combiner must be located on the instructor operating station (IOS), or other location approved by the NSPM. Display format of the repeater must represent that of the combiner. SOC required.	X	X	X	X	See Attachment 2 – Test 4.b.
7.2.1.R	Reserved					
7.2.1.G	N/A.					
7.2.2	ENHANCED FLIGHT VISION SYSTEM (EFVS) (Where fitted)					
7.2.2.S, S1	The EFVS simulator hardware/software, including associated cockpit displays and annunciation, must function the same or equivalent to the EFVS system installed in the airplane.	X	X	X	X	See Attachment 2 – Test 4.c.

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
	A minimum of one airport must be modeled for EFVS operation. The model must include an ILS and a non-precision approach (with VNAV if required for that airplane type). Image must be repeated on the IOS as per HUD requirement in section 7.2.1.S. IOS weather presets must be provided for EFVS minimums.					
7.2.2.R	Reserved					
7.2.2.G	N/A.					
7.3	VISUAL GROUND SEGMENT					
7.3.S, S1	A test is required to demonstrate that the visibility is correct on final approach in CAT II conditions and the positioning of the airplane is correct relative to the runway.	X	X	X	X	See Attachment 2 – Test 4.d.
7.3.R	Reserved					
7.3.G	Reserved					
8.	**FEATURE GENERAL REQUIREMENT MOTION CUES**					
8.S	**N/A.**					
8.R	**Pilot receives an effective and representative motion cue and stimulus, which provides the appropriate sensations of acceleration of the airplane's 6 degrees of freedom (DOF). Motion cues and vibration cues should always provide the correct sensation, to support the approved use.**				X	Characteristic motion vibrations must be measured and compared to airplane data.
8.R1	**Reserved**					
8.R2	**Pilot receives an effective and representative motion cue and stimulus, which provides the appropriate sensations of acceleration of the airplane's 6 degrees of freedom (DOF). Motion cues should always provide the correct sensation, to support the approved use.**			X		
8.R3	**The simulator must have a motion (force cueing) system with a minimum of three degrees of freedom (at least pitch, roll, and heave). Motion effects programming is required.**		X			
8.R4	**The simulator must have a motion (force cueing) system with a minimum of three degrees of freedom (at least pitch, roll, and heave).**	X				
8.G	**N/A.**					
	FEATURE TECHNICAL REQUIREMENT MOTION CUES					
8.1	MOTION CUES GENERAL					
8.1.R,R2	Motion cues (force) in 6 DOF, as perceived by the pilot, must be representative of the simulated airplane's motion (e.g. touchdown cues must be a function of the rate of descent (R/D) of the simulated airplane). SOC required.			X	X	
8.1.R1	Reserved					

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
8.2.R3	Motion cues (force) in 3 DOF, as perceived by the pilot, must be representative of the simulated airplane's motion (e.g. touchdown cues must be a function of the rate of descent (R/D) of the simulated airplane). SOC required.		X			
8.2.R4	Motion cues (force) in 3 DOF, as perceived by the pilot, must be representative of the simulated airplane's motion. SOC required.	X				Touchdown cues should be a function of the rate of descent (R/D) of the simulated airplane
8.2	MOTION FORCE CUEING					
8.2.R,R2	A motion system (force cueing) must produce cues at least equivalent to those of a 6 DOF platform motion system (i.e., pitch, roll, yaw, heave, sway, and surge). SOC required.			X	X	
8.2.R1	Reserved					
8.2.R3,R4	A motion system (force cueing) must produce cues at least equivalent to those of a 3 DOF platform motion system (i.e., pitch, roll, and heave). SOC required.	X	X			
8.3	MOTION EFFECTS					
8.3.R,R2,R3	Motion effects must include characteristic motion vibrations, buffets and bumps that result from operation of the airplane, in so far as these mark an event or airplane state that can be sensed at the cockpit/flight deck. Such effects must be in at least 3 axes, x, y and z, to represent the effects as experienced in the airplane:		X	X	X	See Attachment 3.
8.3.R,R2,R3	(1) Taxiing effects such as lateral and directional cues resulting from steering and braking inputs.		X	X	X	
8.3.R,R2,R3	(2) Effects of runway and taxiway rumble, oleo deflections, uneven runway, runway contamination with associated anti-skid characteristics, center line lights characteristics (such effects should be a function of groundspeed).		X	X	X	
8.3.R,R2,R3	(3) Buffets on the ground due to spoiler/speedbrake extension and thrust reversal.		X	X	X	
8.3.R,R2,R3	(4) Bumps associated with the landing gear.		X	X	X	
8.3.R,R2,R3	(5) Buffet during extension and retraction of landing gear.		X	X	X	
8.3.R,R2,R3	(6) Buffet in the air due to flap and spoiler/speedbrake extension.		X	X	X	
8.3.R,R2,R3	(7) Buffet due to atmospheric disturbances, e.g. turbulence in three linear axes (isotropic).		X	X	X	
8.3.R,R2,R3	(8) Approach to stall buffet.		X	X	X	
8.3.R,R2,R3	(9) Touchdown cues for main and nose gear.		X	X	X	Touchdown bumps should reflect the effects of lateral and directional cues resulting from crab or crosswind landings.
8.3.R,R2,R3	(10) Nosewheel scuffing (if applicable).		X	X	X	
8.3.R,R2,R3	(11) Thrust effect with brakes set.		X	X	X	
8.3.R,R2,R3	(12) Mach and maneuver buffet.		X	X	X	
8.3.R,R2,R3	(13) Tire failure dynamics.		X	X	X	
8.3.R,R2,R3	(14) Engine failures, malfunctions and engine damage.		X	X	X	Appropriate cues to aid recognition of failures for flight critical cases (e.g. directional and lateral cues for asymmetric engine failure).

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
8.3.R,R2,R3	(15) Tail and pod strike.		X	X	X	
8.3.R,R2,R3	(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	X	
8.3.R1	Reserved					
8.3.R4	N/A					
8.4	MOTION VIBRATIONS					
8.4.R	Motion vibrations tests are required and must include recorded results that allow the comparison of relative amplitudes versus frequency (relevant frequencies up to at least 20 Hz). Characteristic motion vibrations that result from operation of the airplane must be present, in so far as vibration marks an event or airplane state that can be sensed at the cockpit/flight deck. The FSTD must be programmed and instrumented in such a manner that the characteristic vibration modes can be measured and compared to airplane data. An SOC is required				X	See Attachment 2 – Table A2A, Section 3.f.
8.4.R	(1) Thrust effects with brakes set.				X	
8.4.R	(2) Landing gear extended buffet.				X	
8.4.R	(3) Flaps extended buffet.				X	
8.4.R	(4) Speedbrake deployed buffet.				X	
8.4.R	(5) Approach to stall buffet.				X	
8.4.R	(6) High speed or Mach buffet.				X	
8.4.R	(7) In-flight vibrations.				X	Propeller-driven airplanes only.
8.4.R,R2	(8) Stall buffet			X	X	Stall buffet vibration measurements are required for all FSTDs qualified to conduct full stall training tasks. See Attachment 2, Table A2A, test 3.f.
8.4.R1	Reserved					
8.4.R2	N/A					
8.4.R3	N/A					
8.4.R4	N/A					
9.	**Reserved**					
10	**FEATURE GENERAL REQUIREMENT ENVIRONMENT — NAVIGATION**					
10.S	**Navigational data with the corresponding approach facilities to support the approved use. Navigation aids must be usable within range or line-of-sight without restriction, as applicable to the geographic area. A complete navigational database is required for at least 3 airport models**			X	X	
10.S1	**Navigational data with the corresponding approach facilities to support the approved use.**	X	X			

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
	Navigation aids must be usable within range or line-of-sight without restriction, as applicable to the geographic area. **A complete navigational database is required for at least 1 airport model**					
10.R	**N/A.**					
10.G	**N/A.**					
	FEATURE TECHNICAL REQUIREMENT ENVIRONMENT - NAVIGATION					
10.1	NAVIGATION DATABASE					
10.1.S,S1	Navigation database sufficient to support simulated airplane systems for real world operations.	X	X	X	X	
10.1.R	N/A.					
10.1.G	N/A.					
10.2	MINIMUM AIRPORT REQUIREMENT					
10.2.S	Complete navigation database for at least 3 airports with corresponding precision and non-precision approach procedures, including navigational database updates.			X	X	
10.2.S1	Complete navigation database for at least 1 airport with corresponding precision and non-precision approach procedures, including navigational database updates.	X	X			
10.2.R	N/A.					
10.2.G	N/A.					
10.3	INSTRUCTOR CONTROLS					
10.3.S,S1	Instructor controls of internal and external navigational aids.	X	X	X	X	E.g. airplane ILS glideslope receiver failure compared to ground facility glideslope failure.
10.3.R	N/A.					
10.3.G	N/A.					
10.4	ARRIVAL / DEPARTURE FEATURES					
10.4.S,S1	Navigational data with all the corresponding standard arrival and departure procedures.	X	X	X	X	
10.4.R	N/A.					
10.4.G	N/A.					
10.5	NAVIGATION AIDS RANGE					
10.5.S,S1	Navigation aids must 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.
10.5.R	N/A.					
10.5.G	N/A.					
11	**FEATURE GENERAL REQUIREMENT** **ENVIRONMENT – ATMOSPHERE AND WEATHER**					
11.S	**N/A.**					
11.R	**Fully integrated dynamic environment simulation including a representative atmosphere with weather effects to support the approved use.**			X	X	

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
	The environment must be synchronized with appropriate airplane and simulation features to provide integrity. Environment simulation must include thunderstorms, wind shear, turbulence, microbursts and appropriate types of precipitation.					
11.G	**Basic atmospheric model, pressure, temperature, visibility, cloud base and winds to support the approved use.** **The environment must be synchronized with appropriate airplane and simulation features to provide integrity.**	**X**	**X**			
	FEATURE TECHNICAL REQUIREMENT ENVIRONMENT – ATMOSPHERE AND WEATHER					
11.1	STANDARD ATMOSPHERE					
11.1.S	N/A.					
11.1.R,G	Simulation of the standard atmosphere including instructor control over key parameters.	**X**	**X**	**X**	**X**	
11.2	WIND SHEAR					
11.2.S	N/A.					
11.2.R	If the aircraft being simulated is one of the aircraft listed in § 121.358, Low-altitude windshear system equipment 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. (4) On final approach, below 500 ft AGL. The QTG must reference the FAA Windshear Training Aid or present alternate airplane 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 training requirements of part 121 pertaining to a certificate holder's approved low-altitude windshear flight training program as described in § 121.409. 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. Any proposed alternate wind models used to meet this requirement must be properly supported and referenced in the Master QTG. Instructor Operating Station (IOS): All required windshear models must be selectable and clearly labeled on the IOS. Additionally, all IOS selectable windshear models must employ a method, such as a simulator preset, to ensure that the FFS is properly configured for use in training. This method must address variables such as windshear			**X**	**X**	Refer to Attachment 2 – Table A2A, Test 2.g. The QTG should reference the FAA *Wind Shear Training Aid* or present alternate airplane-related data, including the implementation method(s) used. If the alternate method is selected, wind models from the Royal Aeroplane Establishment (RAE) *Wind Shear Training*, the *Joint Airport Weather Studies (JAWS) Project* and other recognized sources may be implemented, but should be supported and properly referenced in the QTG. If desired, Level A and B simulators may qualify for windshear training by meeting these standards; see Attachment 5 of this appendix.

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
	intensity, aircraft configurations (weights, flap settings, etc.), and ambient conditions to ensure that the proper windshear recognition cues and training objectives are present as originally qualified.					
11.2.G	Reserved					
11.3	WEATHER EFFECTS					
11.3.S	N/A.					
11.3.R	The following weather effects as observed on the visual system must be simulated and respective instructor controls provided.			X	X	
	(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.					Objective test required. Refer to Attachment 2 – Test 4.d.
	(4) Effects on ownship external lighting.					
	(5) Effects on airport lighting (including variable intensity and fog effects).					
	(6) Surface contaminants (including wind blowing effect).					
	(7) Variable precipitation effects (rain, hail, snow).					
	(8) In-cloud airspeed effect.					
	(9) Gradual visibility changes entering and breaking out of cloud.					
11.3 G	The following weather effects as observed on the visual system must be simulated and respective instructor controls provided.	X	X			
	(1) Visibility.					
11.4	INSTRUCTOR CONTROLS					
11.4.S	N/A.					
11.4.R,G	The following features must be simulated with appropriate instructor controls provided:	X	X	X	X	
	(1) surface wind speed, direction and gusts. Realistic gusting crosswind profiles must be available to the instructor 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 describing source data used to construct gusting crosswind profiles.					Programmed gusting crosswind intensity and rate of change should be based upon data sources such as the FAA Windshear Training Aid or other acceptable source data. Additional tuning of the gusting crosswind profile(s) by a subject matter expert pilot in order to achieve the required training objectives is encouraged.
	(2) intermediate and high altitude wind speed and direction;					
	(3) thunderstorms and microbursts; and					
	(4) turbulence.					
12	**FEATURE GENERAL REQUIREMENT ENVIRONMENT – AIRPORTS AND TERRAIN**					
12.S	**N/A.**					

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
12.R	**Specific airport models with topographical features to support the approved use.** **Correct terrain modeling, runway orientation, markings, lighting, dimensions and taxiways. Visual terrain and EGPWS databases must be matched to support training to avoid CFIT accidents.** **Where the device is required to perform low visibility operations, at least one airport scene with functionality to support the required approval type, e.g. low visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting.**			X	X	See Table A3B and Table A3C in Attachment 3 for specific Class I and Class II airport model requirements.
12.R1	**Specific airport models with topographical features to support the approved use.** **Correct terrain modeling, runway orientation, markings, lighting, dimensions and taxiways. Visual terrain and EGPWS databases must be matched to support training to avoid CFIT accidents.**	X	X			
12.R(S)	**Reserved**					
12.G	**Reserved**					
12.G(S)	**Reserved**					
12.1	VISUAL CUES					
12.1.1R(S) G(S)	Reserved					
12.1.1R	Visual cues to assess sink rate and depth perception during take-off and landing must be provided. This must include: (1) surface on runways, taxiways, and ramps; (2) terrain features; and (3) highly detailed and accurate surface depiction of the terrain surface within an approximate area from 400 m (1/4 sm) before the runway approach end to 400 m (1/4 sm) beyond the runway departure end with a total width of approximately 400 m (1/4 sm) including the width of the runway.			X	X	
12.1.1R1	Visual cues to assess sink rate and depth perception during take-off and landing must be provided. This must include: (1) surface on runways, taxiways, and ramps; and (2) terrain features.		X			
12.1.1G	Reserved					
12.2	VISUAL EFFECTS					
12.2.1R	The system must provide visual effects for: (1) light poles; (2) raised edge lights as appropriate; and			X	X	

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
	(3) glow associated with approach lights in low visibility before physical lights are seen.					
12.3	ENVIRONMENT ATTITUDE					
12.3.1R,R1	The FSTD must provide for accurate portrayal of the visual environment relating to the FSTD attitude.	X	X	X	X	Visual attitude versus FSTD attitude is a comparison of pitch and roll of the horizon as displayed in the visual scene compared to the display on the attitude indicator. Required for initial qualification only (SOC acceptable).
12.4	AIRPORT SCENES					
12.4.1R	The system must include at least 3 designated real-world airports available in daylight, twilight (dusk or dawn) and night illumination states.			X	X	The three required airport models are intended to demonstrate visual system capability and must meet the Class I airport model requirements in Attachment 3, Table A3B.
12.4.1R1	The system must include at least 1 designated real-world airport available in daylight, twilight (dusk or dawn) and night illumination states.	X	X			The required airport model is intended to demonstrate visual system capability and must meet the Class I airport model requirements in Attachment 3, Table A3B.
12.4.1G	Reserved					
12.4.2.1R	Daylight Capability. SOC required for system capability.			X	X	System objective tests are required. See Attachment 2 (visual scene quality) — Test 4.a.
12.4.2.2R	The system must provide full-color presentations and sufficient surfaces with appropriate textural cues to successfully accomplish a visual approach, landing and airport movement (taxi).			X	X	
12.4.2.3R	Surface shading effects must be consistent with simulated sun position.			X	X	This does not imply continuous time of day.
12.4.2.4R	Total scene content comparable in detail to that produced by 10 000 visible textured surfaces and 6 000 visible lights must be provided.			X	X	
12.4.2.4G	Reserved					
12.4.2.5R	The system must have sufficient capacity to display 16 simultaneously moving objects.			X	X	
12.4.3.1R	Twilight (dusk) capability.			X	X	
12.4.3.2R	The system must provide twilight (or dusk) visual scenes with full colour presentations of reduced ambient intensity and typical terrain characteristics such as fields, roads and bodies of water and surfaces illuminated by representative ownship lighting (e.g. landing lights) sufficient to successfully accomplish visual approach, landing and airport movement (taxi).			X	X	
12.4.3.3R	Total scene content comparable in detail to that produced by 10 000 visible textured surfaces and 15 000 visible lights must be provided.			X	X	
12.4.3.3R	Scenes must 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	
12.4.3.4R	The system must include a definable horizon.			X	X	If provided, directional horizon lighting should have correct orientation and be consistent with surface shading effects.

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
12.4.3.6R	The system must have sufficient capacity to display 16 simultaneously moving objects.			X	X	
12.4.4R,R1	Night capability.	X	X	X	X	
12.4.4.1R,R1	The system must 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 airplane lights (e.g. landing lights).	X	X	X	X	
12.5	AIRPORT CLUTTER					
12.5.1R	Airport models must include representative static and dynamic clutter such as gates, airplanes, and ground handling equipment.			X	X	Clutter need not be dynamic unless required (e.g. ATC correlation).
12.6	DATABASE CURRENCY					
12.6.1R,R1	The specific airports used in the system must be maintained current with the state of the corresponding real-world airports as identified in the airport charts.	X	X	X	X	Specific requirements for maintaining airport model currency are described in Attachment 3, Paragraph (f).
12.7	Reserved					
12.8	Reserved					
12.9	LOW VISIBILITY TRAINING					
12.9.1R	The system must include at least one airport scene with functionality to support the required approval type, e.g. low visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting.			X	X	
13	**FEATURE GENERAL REQUIREMENT MISCELLANEOUS**					
13.S	**N/A.**					
13.S1	**N/A.**					
13.R	**N/A.**					
13.G	**N/A.**					
13	FEATURE TECHNICAL REQUIREMENT MISCELLANEOUS					
13.1	INSTRUCTOR OPERATING STATION					
13.1S,S1	The instructor station must provide an adequate view of the pilots' panels and forward windows.	X	X	X	X	For an FSTD with a motion cueing system, any on board instructor seat should be adequately secured and fitted with positive restraint devices of sufficient integrity to safely restrain the occupant during any known or predicted motion system excursion.
13.1R	Reserved					
13.1G	N/A.					
13.2	INSTRUCTOR CONTROLS					
13.2 S,S1	Instructor controls must be provided for all required system variables, freezes, resets and for insertion of malfunctions to simulate abnormal or emergency conditions. The effects of these malfunctions must be sufficient to correctly exercise the procedures in relevant operating manuals.	X	X	X	X	
13.3	SELF–DIAGNOSTIC TESTING					

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
13.3S,S1	Self-diagnostic testing of the FSTD must be available to determine the integrity of hardware and software operation and to provide a means for quickly and effectively conducting daily testing of the FSTD software and hardware. An SOC is required	X	X	X	X	
13.4	COMPUTER CAPACITY					
13.4 S,S1	Sufficient FSTD computer capacity, accuracy, resolution and dynamic response must be provided to fully support the overall FSTD fidelity needed to meet the qualification type sought. An SOC is required.	X	X	X	X	
13.5	AUTOMATIC TESTING FACILITIES					
13.5S,S1	Automatic QTG/validation testing of FSTD hardware and software to determine compliance with the validation requirements must be available.	X	X	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 airplane standard.
13.5 R,G	Reserved					
13.6	UPDATES TO FSTD HARDWARE AND SOFTWARE					
13.6 S,S1	Timely permanent update of FSTD hardware and software must be conducted subsequent to airplane modification where it affects training, sufficient for the qualification type sought.	X	X	X	X	
13.6G	Reserved					
13.7	DAILY PRE-FLIGHT DOCUMENTATION					
13.7 S,S1	Daily pre-flight documentation either in the daily log or in a location easily accessible for review is required.	X	X	X	X	
13.8	SYSTEM INTEGRATION					
13.8	System Integration. Relative response of the visual system, cockpit/flight deck instruments and initial motion system coupled closely to provide integrated sensory cues. Visual scene changes from steady state disturbance (i.e. the start of the scan of the first video field containing different information) must occur within the system dynamic response limit of 100 milliseconds (ms). Motion onset must also occur within the system dynamic response limit of 100 ms. While motion onset must occur before the start of the scan of the first video field containing different information, it needs to occur before the end of the scan of the same video field. The test to determine compliance with these requirements must include simultaneously recording the output from the pilot's pitch, roll and yaw controllers, the output from the accelerometer attached to the motion system platform located at an acceptable location near the pilots' seats, the output signal to the visual system display (including visual system analogue delays) and the output signal to the pilot's attitude indicator or an equivalent test approved by the NSPM.					Test required. See Attachment 2, Table A2A, Transport delay – Test 6.a. Latency test may be used as an alternate means of compliance in place of the transport delay test. Attachment 2, Paragraph 15 provides guidance for transport delay test methodology and also latency.
13.8S	Transport delay: A transport delay test may be used to demonstrate that the FSTD system response does not exceed 100 ms. Where EFVS systems are installed, they must respond within + or - 30 ms from the visual system, and not before the motion response.			X	X	Results required for instruments, motion and visual systems. Additional transport delay test results are required where HUD systems are installed, which are simulated and not actual airplane

Table A1A

Minimum Simulator Requirements						
	QPS REQUIREMENTS	Simulator Levels				INFORMATION
Entry Number	General Simulator Requirements	A	B	C	D	Notes
						systems. Where a visual system's mode of operation (daylight, twilight and night) can affect performance, additional tests are required. An SOC is required where the visual system's mode of operation does not affect performance, precluding the need to submit additional tests.
13.8S1	Transport delay: A transport delay test may be used to demonstrate that the FSTD system response does not exceed 300 ms. Where EFVS systems are installed, they must respond within + or - 30 ms from the visual system, and not before the motion response.	X	X			Results required for instruments, motion and visual systems. Additional transport delay test results are required where HUD systems are installed, which are simulated and not actual airplane systems. Where a visual system's mode of operation (daylight, twilight and night) can affect performance, additional tests are required. An SOC is required where the visual system's mode of operation does not affect performance, precluding the need to submit additional tests.
13.8 R.G	Reserved					

Table A1B

Table of Tasks vs. Simulator Level						
QPS REQUIREMENTS						INFORMATION
Entry Number	Subjective Requirements In order to be qualified at the simulator qualification level indicated, the simulator must be able to perform at least the tasks associated with that level of qualification.	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	A	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 Stalls	X	X			
3.b.2	Full Stalls			X	X	Stall maneuvers at angles of attack above the activation of the stall warning system.
3.c.	Engine Failure—Multiengine Airplane	X	X	X	X	
3.d.	Engine Failure—Single-Engine Airplane	X	X	X	X	
3.e.	Specific Flight Characteristics incorporated into the user's FAA approved flight training program.	A	A	A	A	
3.f.	Upset Recognition and Recovery			X	X	Upset recovery maneuvers conducted within the FSTD's defined validation envelope.
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					
4.c.1.	All engines operating.	X	X	X	X	e.g., Autopilot, Manual (Flt. Dir. Assisted), Manual (Raw Data)

"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.
"X" - indicates that the simulator must be able to perform this task for this level of qualification.

Table A1B

Table of Tasks vs. Simulator Level						
QPS REQUIREMENTS						INFORMATION
Entry Number	Subjective Requirements In order to be qualified at the simulator qualification level indicated, the simulator must be able to perform at least the tasks associated with that level of qualification.	Simulator Levels				Notes
		A	B	C	D	
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.e.	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 Airplane		R	X	X	
5.d.	Landing From Circling Approach		R	X	X	
5.e.	Rejected Landing	X	X	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.b.	Fuel System	X	X	X	X	
6.c.	Electrical System	X	X	X	X	
6.d.	Hydraulic System	X	X	X	X	
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	

"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.

"X" - indicates that the simulator must be able to perform this task for this level of qualification.

Table A1B

Table of Tasks vs. Simulator Level						
QPS REQUIREMENTS						INFORMATION
Entry Number	Subjective Requirements In order to be qualified at the simulator qualification level indicated, the simulator must be able to perform at least the tasks associated with that level of qualification.	Simulator Levels				Notes
		A	B	C	D	
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. Postflight 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.
"X" - indicates that the simulator must be able to perform this task for this level of qualification.

Table A1C

Table of Simulator System Tasks						
QPS REQUIREMENTS						**INFORMATION**
Entry Number	**Subjective Requirements** In order to be qualified at the simulator qualification level indicated, the simulator must be able to perform at least the tasks associated with that level of qualification.	**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.	Airplane conditions.	**X**	**X**	**X**	**X**	e.g., GW, CG, Fuel loading and Systems.
1.c.	Airports / Runways.	**X**	**X**	**X**	**X**	e.g., Selection, Surface, Presets, Lighting controls.
1.d.	Environmental controls.	**X**	**X**	**X**	**X**	e.g., Clouds, Visibility, RVR, Temp, Wind, Ice, Snow, Rain, and Windshear.
1.e.	Airplane 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 / Positive restraint system.	**X**	**X**	**X**	**X**	

Attachment 2 to Appendix A to Part 60--
FFS OBJECTIVE TESTS

Table of Contents

Paragraph Number	Title
1.	**Introduction**
2.	**Test Requirements**
	Table A2A, Objective Tests
3.	***General***
4.	Control Dynamics
5.	Ground Effect
6.	Motion System
7.	Sound System
8.	Additional Information About Flight Simulator Qualification for New or Derivative Airplanes
9.	Engineering Simulator – Validation Data
10.	[Reserved]
11.	Validation Test Tolerances
12.	Validation Data Roadmap
13.	Acceptance Guidelines for Alternative Engines Data
14.	Acceptance Guidelines for Alternative Avionics (Flight-Related Computers and Controllers)
15.	Transport Delay Testing
16.	Continuing Qualification Evaluations – Validation Test Data Presentation
17.	Alternative Data Sources, Procedures, and Instrumentation: Level A and Level B Simulators Only
18.	Visual Display Systems – Additional Information on Image Geometry Testing

Begin Information

1. Introduction

a. For the purposes of this attachment, the flight conditions specified in the Flight Conditions Column of Table A2A of this appendix, are defined as follows:

(1) Ground—on ground, independent of airplane configuration;

(2) Take-off—gear down with flaps/slats in any certified takeoff position;

(3) First segment climb—gear down with flaps/slats in any certified takeoff position (normally not above 50 ft AGL);

(4) Second segment climb—gear up with flaps/slats in any certified takeoff position (normally between 50 ft and 400 ft AGL);

(5) Clean—flaps/slats retracted and gear up;

(6) Cruise—clean configuration at cruise altitude and airspeed;

(7) Approach—gear up or down with flaps/slats at any normal approach position as recommended by the airplane manufacturer; and

(8) Landing—gear down with flaps/slats in any certified landing position.

b. The format for numbering the objective tests in Appendix A, Attachment 2, Table A2A, and the objective tests in Appendix B, Attachment 2, Table B2A, is identical. However, each test required for FFSs is not necessarily required for FTDs. Also, each test required for FTDs is not necessarily required for FFSs. Therefore, 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 FFSs or FTDs.

c. The reader is encouraged to review the Airplane Flight Simulator Evaluation Handbook, Volumes I and II, published by the Royal Aeronautical Society, London, UK, and AC 25–7, as amended, Flight Test Guide for Certification of Transport Category Airplanes, and AC 23–8, as amended, Flight Test Guide for Certification of Part 23 Airplanes, for references and examples regarding flight testing requirements and techniques.

d. 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.

End Information

Begin QPS Requirements

2. Test Requirements

a. The ground and flight tests required for qualification are listed in Table of A2A, FFS Objective Tests. Computer generated simulator test results must be provided for each test except where an alternative test is specifically authorized by the NSPM. If a flight condition or operating condition is required for the test but does not apply to the airplane being simulated or to the qualification level sought, it may be disregarded (e.g., an engine out missed approach for a single-engine airplane or a maneuver using reverse thrust for an airplane without reverse thrust capability). Each test result is compared against the validation data described in § 60.13 and in this appendix. 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, it must be possible to conduct each test manually while recording all appropriate parameters. The results must be produced on an appropriate recording device acceptable to the NSPM and must include simulator number, date, time, conditions, tolerances, and appropriate dependent variables portrayed in comparison to the validation data. Time histories are required unless

otherwise indicated in Table A2A. All results must be labeled using the tolerances and units given.

b. Table A2A in this attachment sets 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 and 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 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.

c. Certain tests included in this attachment must be supported with an SOC. In Table A2A, requirements for SOCs are indicated in the ''Test Details'' column.

d. When operational or engineering judgment is used in making assessments for flight test data applications for simulator validity, such judgment must not be limited to a single parameter. For example, data that exhibit rapid variations of the measured parameters may require interpolations or a ''best fit'' data selection. All relevant parameters related to a given maneuver or flight condition must be provided to allow overall interpretation. When it is difficult or impossible to match simulator to airplane data throughout a time history, differences must be justified by providing a comparison of other related variables for the condition being assessed.

e. It is not acceptable to program the FFS so that the mathematical modeling is correct only at the validation test points. Unless otherwise noted, simulator tests must represent airplane performance and handling qualities at operating weights and centers of gravity (CG) typical of normal operation. If a test is supported by airplane data at one extreme weight or CG, another test supported by airplane data at mid-conditions or as close as possible to the other extreme must be included. Certain tests that are relevant only at one extreme CG or weight condition need not be repeated at the other extreme. Tests of handling qualities must include validation of augmentation devices.

f. When comparing the parameters listed to those of the airplane, sufficient data must also be provided to verify the correct flight condition and airplane configuration changes. For example, to show that control force is within the parameters for a static stability test, data to show the correct airspeed, power, thrust or torque, airplane configuration, altitude, and other appropriate datum identification parameters must also be given. If comparing short period dynamics, normal acceleration may be used to establish a match to the airplane, but airspeed, altitude, control input, airplane configuration, and other appropriate data must also be given. If comparing landing gear change dynamics, pitch, airspeed, and altitude may be used to establish a match to the airplane, but landing gear position must also be provided. 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).

g. 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, but overall integrated testing of the simulator must be accomplished to assure that the total simulator system meets the prescribed standards. A manual test procedure with explicit and detailed steps for completing each test must also be provided.

h. For previously qualified simulators, the tests and tolerances of this attachment may be used in subsequent continuing qualification evaluations for any given test if the sponsor has submitted a proposed MQTG revision to the NSPM and has received NSPM approval.

i. Simulators are evaluated and qualified with an engine model simulating the airplane data supplier's flight test engine. For qualification of alternative engine models (either variations of the flight test engines or other manufacturer's engines) additional tests with the alternative engine models may be required. This attachment contains guidelines for alternative engines.

j. For testing Computer Controlled Aircraft (CCA) simulators, or other highly augmented airplane simulators, flight test data is required for the Normal (N) and/or Non-normal (NN) control states, as indicated in this attachment. 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 NSPM will determine what tests are appropriate for airplane simulation data. When making this determination, the NSPM may require other levels of control state degradation for specific airplane 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:

(1) Pilot controller deflections or electronically generated inputs, including location of input; and

(2) Flight control surface positions unless test results are not affected by, or are independent of, surface positions.

k. Tests of handling qualities must include validation of augmentation devices. FFSs for highly augmented airplanes will be validated both in the unaugmented configuration (or failure state with the maximum permitted degradation in handling qualities) and the augmented configuration. Where various levels of handling qualities result from failure states, validation of the effect of the failure is necessary. Requirements for testing will be mutually agreed to between the sponsor and the NSPM on a case-by-case basis.

l. Some tests will not be required for airplanes using airplane hardware in the simulator flight deck (e.g., ''side stick controller''). These exceptions are noted in Section 2 ''Handling Qualities'' in Table A2A of this attachment. However, in these cases, the sponsor must provide a statement that the airplane hardware meets the appropriate manufacturer's specifications and the sponsor must have supporting information to that fact available for NSPM review.

m. For objective test purposes, see Appendix F of this part for the definitions of ''Near maximum,'' ''Light,'' and ''Medium'' gross weight.

End QPS Requirements

Begin Information

n. In those cases where the objective test results authorize a ''snapshot test'' or a ''series of snapshot tests'' results in lieu of a time-history result, the sponsor or other data provider must ensure that a steady state condition exists at the instant of time captured by the ''snapshot.'' The steady state condition should exist from 4 seconds prior to, through 1 second following, the instant of time captured by the snap shot.

o. For references on basic operating weight, see AC 120–27, ''Aircraft Weight and Balance;'' and FAA- H–8083–1, ''Aircraft Weight and Balance Handbook.''

End Information

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
1. Performance.									
1.a.	**Taxi.**								
1.a.1	Minimum radius turn.	±0.9 m (3 ft) or ±20% of airplane 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 airplanes 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 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).*					
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 V_r. 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.
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 airplane lateral deviation reached or ±1.5 m (5 ft). For airplanes with reversible flight control systems: ±10% or ±2.2 daN (5 lbf) rudder pedal force.	Takeoff.	Engine failure speed must be within ±1 kt of airplane 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 airplane manufacturer's flight test engine, a further test may be run with the same initial conditions using the thrust from the flight test data as the driving parameter. To ensure only aerodynamic control, nosewheel steering must be disabled (i.e. castored) or the nosewheel held slightly off the ground.	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 V_1 and V_1-10 kt, followed by control of heading using aerodynamic control only and recovery should be achieved with the main gear on the ground.
1.b.3	Minimum unstick speed (V_{mu}) or equivalent test to demonstrate early	±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	V_{mu} is defined as the minimum speed at which the last main landing gear leaves

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
	rotation take-off characteristics.								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 airplane, should be active.
1.b.4	Normal take-off.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±6 m (20 ft) height. For airplanes 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 airplane 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.
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 airplanes with	Takeoff.	Record takeoff profile to at least 61 m (200 ft) AGL. Engine failure speed must be within ±3 kt of airplane data. Test at near maximum takeoff weight.	X	X	X	X	

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		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.							
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 airplanes 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	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 airplane 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 NSPM.

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		±2.2 daN (5 lbf) or ±10% of rudder pedal force.							
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 V_1. 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 airplane 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, airplane flight test may be performed out of ground effect at a safe altitude, but with correct airplane configuration and airspeed.
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, airplane 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 airplane performance	2nd segment climb.	Flight test data is preferred; however, airplane performance manual data is an acceptable alternative. Record at nominal climb speed.	X	X	X	X	

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		data requirements.		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.					
1.c.3.	One Engine Inoperative En route Climb.	±10% time, ±10% distance, ±10% fuel used	Clean	Flight test data or airplane performance manual data may be used. Test for at least a 1550 m (5 000 ft) segment.			**X**	**X**	
1.c.4.	One Engine Inoperative Approach Climb for airplanes with icing accountability if provided in the airplane 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 airplane performance data.	Approach	Flight test data or airplane 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**	Airplane 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 airplane 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 airplanes 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 airplanes with a small operating speed range, speed change may be reduced to 80% of operational speed change.	**X**	**X**	**X**	**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**	**X**	
1.d.4.	Idle descent.	±3 kt airspeed.	Clean.	Idle power stabilized descent at normal descent speed at mid altitude.	**X**	**X**	**X**	**X**	

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		±1.0 m/s (200 ft/min) or ±5% of rate of descent.		FSTD performance to be recorded over an interval of at least 300 m (1 000 ft).					
1.d.5.	Emergency descent.	±5 kt airspeed. ±1.5 m/s (300 ft/min) or ±5% of rate of descent.	As per airplane 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 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**	**X**	**X**	**X**	
1.e.2.	Deceleration time and distance, reverse thrust, no wheel brakes, dry runway.	±1.5 s or ±5% of time; and the smaller of ±61 m (200 ft) or ±10% of distance.	Landing	Time and distance 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**	
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			**X**	**X**	

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
				runway braking coefficients, are an acceptable alternative.					
1.e.4.	Stopping distance, wheel brakes, icy runway.	±61 m (200 ft) or ±10% of distance.	Landing.	Either flight test or manufacturer's performance manual data 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 Appendix F of this part for definitions of T_i and T_t.
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 maximum takeoff power to idle power.	X	X	X	X	See Appendix F of this part for definitions of T_i and T_t.
2. **Handling Qualities.**									
	Note 1.— Pitch, roll and yaw controller position versus force or time must 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 airplane 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 must be accomplished at the same feel or impact pressures as the validation data where applicable. *Note 2.— FSTD 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.*								Contact the NSPM for clarification of any issue regarding airplanes with reversible controls.
2.a.	**Static Control Tests.**								
	Note.— Testing of position versus force is not applicable if forces are generated solely by use of airplane hardware in the FSTD.								
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.

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
2.a.1.b.	**(Reserved)**								
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.	±2.2 daN (5 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force. ±2° rudder 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.3.b.	**(Reserved)**								
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 of an uninterrupted control sweep to the stops.	X	X	X	X	
2.a.5.	Rudder Pedal Steering Calibration.	±2° NWA.	Ground.	Record results of 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 software 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	
2.a.8.	Alignment of cockpit	When matching engine	Ground.	Simultaneous recording for all engines. The	X	X	X	X	Data from a test airplane or

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
	throttle lever versus selected engine parameter.	parameters: ±5° of TLA. When matching detents: ±3% N1 or ±.03 EPR or ±3% torque, or equivalent. Where the levers do not have angular travel, a tolerance of ±2 cm (±0.8 in) applies.		tolerances apply against airplane data. For airplanes with throttle detents, all detents to be presented and at least one position between detents/ endpoints (where practical). For airplanes without detents, end points and at least three other positions are to be presented.					engineering test bench are acceptable, provided the correct engine controller (both hardware and software) is used. In the case of propeller-driven airplanes, 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.
2.a.10	Stick Pusher System Force Calibration	±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**	**X**	**X**	Aircraft manufacturer design data may be utilized as validation data as determined acceptable by the NSPM. Test requirement may be met through column force validation testing in conjunction with the Stall Characteristics test (2.c.8).
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 airplane controller unit installed in the FSTD. Power setting may be that required for level flight unless otherwise specified. See paragraph 4 of this attachment..								
2.b.1.	Pitch Control.	**For underdamped systems**: $T(P_0)$ ±10% of P_0 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).			**X**	**X**	n = the sequential period of a full oscillation. Refer to paragraph 4 of this Attachment.

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		$T(P_1)$ ±20% of P_1 or ±0.05 s. $T(P_2)$ ±30% of P_2 or ±0.05 s. $T(P_n)$ ±10*(n+1)% of P_n or ±0.05 s. $T(A_n)$ ±10% of A_{max}, where A_{max} is the largest amplitude or ±0.5% of the total control travel (stop to stop). $T(A_d)$ ±5% of A_d = residual band or ±0.5% of the maximum control travel = residual band. ±1 significant overshoots (minimum of 1 significant overshoot). Steady state position within residual band. *Note 1.— Tolerances should not be applied on period or amplitude after the last significant overshoot.* *Note 2.— Oscillations within the residual band are not considered significant and are not subject to tolerances.* **For overdamped and**		Tolerances apply against the absolute values of each period (considered independently).					

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		critically damped systems only, the following tolerance applies: $T(P_0)$ ±10% of P_0 or ±0.05 s.							
2.b.2.	Roll Control.	Same as 2.b.1.	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 paragraphs 4 of this Attachment.
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 paragraphs 4 of this Attachment.
2.b.4.	Small Control Inputs – Pitch.	±0.15°/s body pitch rate or ±20% of peak body pitch rate applied throughout the time history.	Approach or Landing.	Control inputs 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**	**X**	
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 airplanes 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.			**X**	**X**	

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
				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.					
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.**								
	Power setting is that required for level flight unless otherwise specified.								
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.	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.	**X**	**X**	**X**	**X**	

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		±1.5° or ±20% of pitch angle.		**CCA:** Test in normal and non-normal control mode					
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**	
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 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**	
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 airplane hardware in the FSTD.	**X**	**X**	**X**	**X**	

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
				Alternative method applies to airplanes which do not exhibit stick-force-per-g characteristics. **CCA:** Test in normal or non-normal control mode					
2.c.7.	Longitudinal Static Stability.	±2.2 daN (5 lbf) or ±10% of pitch controller force. Alternative method: ±1° or ±10% of the change of elevator angle.	Approach.	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 airplane hardware in the FSTD. Alternative method applies to airplanes 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	Approach to Stall Characteristics	±3 kt airspeed for initial buffet, stall warning, and stall speeds. Control displacements and flight control surfaces 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 ±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 approach to stall entry methods must be demonstrated in at least one of the three required 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 required cruise condition must be conducted in a flaps-up (clean) configuration. The second segment climb and approach/landing conditions must be conducted at different flap settings. **CCA:** Test in Normal and Non-normal control states as applicable.	**X**	**X**			Tests may be conducted at centers of gravity and weights typically required for airplane certification stall testing.

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
2.c.8.b	Stall Characteristics	±3 kt airspeed for initial buffet, stall warning, and stall speeds. Control displacements and flight control surfaces must be plotted and demonstrate correct trend and magnitude. For speeds greater than stick shaker or initial buffet speed: ±2.0° pitch angle ±2.0° angle of attack ±2.0° bank angle ±2.0° sideslip angle For speeds less than stick shaker or initial buffet speed to stall break: ±2.0° pitch angle ±2.0° angle of attack Correct trend and magnitude for roll rate and yaw rate. Stall Break and Recovery: SOC Required (see Attachment 7) ±10% or ±5 lb (2.2 daN)) Stick/Column force (prior to "g break" only). See general requirements (high angle of attack modeling) for additional requirements on stick pusher system modeling.	Second Segment Climb, High Altitude Cruise (Near Performance Limited Condition), and Approach or Landing	Each of the following stall entry methods must be demonstrated in at least one of the three required 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 required cruise condition must be conducted in a flaps-up (clean) configuration. The second segment climb and approach/landing conditions must be conducted at different flap settings. 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 airplanes exhibiting a sudden pitch attitude change or "g break" must demonstrate this characteristic. FSTDs of airplanes exhibiting a roll off and/or loss of roll control authority must demonstrate this characteristic. Numerical tolerances on pitch angle and angle of attack are not applicable past the aerodynamic stall (g-break, pitch break, etc.) but must demonstrate correct trend through recovery. For aircraft equipped with a stall identification system (e.g. stick pusher), flight test validation data to the aerodynamic stall is not required where the system is required to be operational for aircraft dispatch. **CCA:** Test in Normal and Non-normal control states as applicable. .			X	X	Initial buffet onset speed should be based on .03 g peak to peak normal acceleration above the background noise at the pilot seat. Demonstrate correct trend in growth of buffet amplitude from initial buffet to stall speed for normal and lateral acceleration – device manufacturer may limit maximum buffet based on motion platform capability/limitations Tests may be conducted at centers of gravity and weights typically required for airplane certification stall testing.

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	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.**								
	Power setting is that required for level flight unless otherwise specified.								
2.d.1.	Minimum control speed, air (V_{mca}) or landing (V_{mcl}), per applicable airworthiness requirement or low speed engine-inoperative handling characteristics in the air.	±3 kt airspeed.	Takeoff or Landing (whichever is most critical in the airplane).	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 V_{mca} or V_{mcl} in the conventional manner.
2.d.2.	Roll Response (Rate).	±2°/s or ±10% of roll rate. For airplanes with reversible flight control systems: ±1.3 daN (3 lbf) or ±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.	±2° or ±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

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
									approximately 10 seconds of airplane free response.
2.d.4.	Spiral Stability.	Correct trend and ±2° or ±10% of roll angle in 20 s. If alternate test is used: correct trend and ±2° aileron angle.	Cruise, and Approach or Landing.	Airplane 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**	
2.d.5.	Engine Inoperative Trim.	±1° rudder angle or ±1° tab angle or equivalent rudder pedal. ±2° 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.	±2°/s or ±10% of yaw rate.	Approach or Landing.	Test with stability augmentation on and off. Test with a step input at approximately 25% of full rudder pedal throw. **CCA:** Test in normal and non-normal control mode	**X**	**X**	**X**	**X**	
2.d.7.	Dutch Roll	±0.5 s or ±10% of period. ±10% of time to one half or double amplitude or ±.02 of damping ratio. ±1 s or ±20% of time difference between peaks of roll angle and	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**	

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		side-slip angle.							
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 airplanes 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 airplanes), one of which must be near maximum allowable rudder.	X	X	X	X	
2.e.	**Landings.**								
2.e.1.	Normal Landing.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±3 m (10 ft) or ±10% of height. For airplanes with reversible flight control	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.

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		systems: ±2.2 daN (5 lbf) or ±10% of column force.							
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 airplanes 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**	
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 airplanes with reversible flight control systems: ±2.2 daN (5 lbf) or ±10% of	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 airplane 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 NSPM.

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		column force. ±1.3 daN (3 lbf) or ±10% of wheel force. ±2.2 daN (5 lbf) or ±10% of rudder pedal force.							
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 Tf. ±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 Appendix F of this part for definition of T_f.
2.e.6.	All-engine autopilot go-around.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA.	As per airplane performance data.	Normal all-engine autopilot go-around must be demonstrated (if applicable) at medium weight.		**X**	**X**	**X**	
2.e.7.	One engine	±3 kt airspeed.	As per airplane	Engine inoperative go-around required near		**X**	**X**	**X**	

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
	inoperative go around.	±1.5° pitch angle. ±1.5° AOA. ±2° roll angle. ±2° side-slip angle.	performance data.	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.					
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	
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.**								
	Test to demonstrate Ground Effect.	±1° elevator angle. ±0.5° stabilizer angle. ±5% of net thrust or equivalent. ±1° AOA. ±1.5 m (5 ft) or ±10% of height. ±3 kt airspeed. ±1° pitch angle.	Landing.	A rationale must be provided with justification of results. **CCA:** Test in normal or non-normal control mode, as applicable.		X	X	X	See paragraph 5 of this Attachment for additional information.
2.g.	**Windshear.**								
	Four tests, two takeoff and two landing, with one of each conducted in still air and the other with windshear active	See Attachment 5 of this appendix.	Takeoff and Landing.	Requires windshear models that provide training in the specific skills needed to recognize windshear phenomena and to execute recovery procedures. See Attachment 5 of this appendix for tests, tolerances, and procedures.			X	X	See Attachment 5 of this appendix for information related to Level A and B simulators.

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
	to demonstrate windshear models.								
2.h.	**Flight Maneuver and Envelope Protection Functions.**								
	Note. The requirements of 2.h are only applicable to computer-controlled airplanes. 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	
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	
2.i.	Engine and Airframe Icing Effects Demonstration (Aerodynamic Stall)		Takeoff, Approach, or Landing	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 must include, but are not limited to the following effects as applicable to the particular airplane: ▪ 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 onset.			X	X	Tests will be evaluated for representative effects on relevant aerodynamic 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

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
				▪ Engine effects (power reduction/variation, vibration, etc.)					
3. Motion System.									
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 paragraph 6 of this Attachment.
3.b.	**Turn-around check.**								
		As specified by the sponsor for FSTD qualification.	Not applicable.	Appropriate test to demonstrate required smooth turn-around.	X	X	X	X	See paragraph 6 of this Attachment.
3.c	**Motion effects.**				X	X	X	X	Refer to Appendix C of this Part on subjective testing.
3.d.	**Motion system repeatability.**								
	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 6.c. of this Attachment.
3.e.	**Motion cueing fidelity**								
3.e.1.	Motion cueing fidelity – Frequency-domain criterion.	As specified by the sponsor for flight simulator 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 during the initial FSTD qualification.	X	X	X	X	See paragraph 6.d. of this Attachment.
3.e.2.	Reserved								
3.f	Characteristic motion vibrations. The following tests	None.	Ground and flight.					X	The recorded test results for characteristic buffets should allow the comparison of

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
	with recorded results and an SOC are required for characteristic motion vibrations, which can be sensed at the flight deck where applicable by airplane type.								relative amplitude versus frequency. See also paragraph 6.e. of this Attachment.
3.f.1.	Thrust effect with brakes set.	The FSTD test results must exhibit the overall appearance and trends of the airplane data, with at least three (3) of the predominant frequency "spikes" being present within ± 2 Hz of the airplane data.	Ground.	Test must be conducted at maximum possible thrust with brakes set.				**X**	
3.f.2.	Buffet with landing gear extended.	The FSTD test results must exhibit the overall appearance and trends of the airplane data, with at least three (3) of the predominant frequency "spikes" being present within ± 2 Hz of the airplane data.	Flight.	Test condition must be for a normal operational speed and not at the gear limiting speed.				**X**	
3.f.3.	Buffet with flaps extended.	The FSTD test results must exhibit the overall appearance and trends of the airplane data, with at least three (3) of the predominant frequency "spikes" being present within ± 2 Hz of the airplane data.	Flight.	Test condition must be at a normal operational speed and not at the flap limiting speed.				**X**	
3.f.4.	Buffet with speedbrakes deployed.	The FSTD test results must exhibit the overall appearance and trends of the airplane data, with at least three (3) of the predominant frequency "spikes" being present within ± 2	Flight.	Test condition must be at a typical speed for a representative buffet.				**X**	

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		Hz of the airplane data.							
3.f.5.	Buffet at approach-to-stall.	The FSTD test results must exhibit the overall appearance and trends of the airplane data, with at least three (3) of the predominant frequency "spikes" being present within ± 2 Hz of the airplane data.	Flight.	Test condition must be at approach to stall. Post-stall characteristics are not required.				X	
3.f.6.	Buffet at high airspeeds or high Mach.	The FSTD test results must exhibit the overall appearance and trends of the airplane data, with at least three (3) of the predominant frequency "spikes" being present within ± 2 Hz of the airplane data.	Flight.					X	Test condition should be for high-speed maneuver buffet/wind-up-turn or alternatively Mach buffet.
3.f.7.	In-flight vibrations for propeller driven airplanes.	The FSTD test results must exhibit the overall appearance and trends of the airplane data, with at least three (3) of the predominant frequency "spikes" being present within ± 2 Hz of the airplane data.	Flight (clean configuration).					X	Test should be conducted to be representative of in-flight vibrations for propeller-driven airplanes.
3.f.8	Buffet at stall.	The FSTD test results must exhibit the overall appearance and trends of the airplane data, with at least three (3) of the predominant frequency "spikes" being present within ± 2 Hz of the airplane data.	Cruise (High Altitude) and Second Segment Climb, or Approach or Landing	Tests must be conducted for approach to stall at angles of attack between the initial buffet and the critical angle of attack. Post stall characteristics are not required. Test required only for those FSTDs qualified for full stall training tasks.			X	X	If stabilized flight data between initial buffet and stall speed are not available, PSD analysis should be conducted for a time span between initial buffet and stall speed.
4. Visual System.									
4.a.	**Visual scene quality**								
4.a.1.	Continuous collimated cross-cockpit visual field of view.	Cross-cockpit, collimated visual display providing each pilot with a minimum of	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)

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		200° horizontal and 40° vertical continuous field of view.							consisting of a matrix of black and white 5° squares. Installed alignment should be confirmed in an SOC (this would generally consist of results from acceptance testing).
	Continuous 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 simultaneously.	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.
4.a.2.	System geometry								
4.a.2.a.1	System geometry – Image position.	From each eyepoint position the center of the image is between 0° and 2° inboard in the horizontal plane and within +/-0.25° vertically. The difference between the left and right horizontal angles must not exceed 1°.	Not applicable.				X	X	The image position should be checked relative to the FSTD centerline. Where there is a design offset in the vertical display center this should be stated.
4.a.2.a.2	System geometry – Absolute geometry.	Within the central 200° x 40°, all points on a 5-degree grid must fall within 3° of the design position as measured from each pilot eyepoint.	Not applicable.				X	X	Where a system with more than 200° x 40° is supplied, the geometry outside the central area should not have any distracting discontinuities.
4.a.2.a.3	System geometry – Relative geometry.	Measurements of relative dot positions must be made every 5 degrees.	Not applicable.				X	X	For a diagram showing zones 1, 2 and 3 and further discussion of this test, see paragraph 18 of this Attachment.

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		In the area from -10° to the lowest visible point at 15° azimuth inboard, 0°, 30°, 60° and 90° degrees outboard for each pilot position, vertical measurements must be made every 1° to the edge of the visible image. The relative position from one point to the next must not exceed: Zone 1: 0.075°/degree; Zone 2: 0.15°/degree; Zone 3: 0.2°/degree.							*Note.— A means to perform this check with a simple go/no go gauge is encouraged for recurrent testing.*
4.a.3	Surface resolution (object detection).	Not greater than 2 arc minutes.	Not applicable.				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. 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.
4.a.4	Light point size.	Not greater than 5 arc minutes.	Not applicable.				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

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
									a horizontal and vertical row. It should be possible to move the light points relative to the eyepoint in all axes. At a point where modulation is just discernible in each visual channel, a calculation should be made to determine the light spacing. An SOC is required to state test method and calculation.
4.a.5	Raster surface contrast ratio.	Not less than 5:1.	Not applicable.				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/m^2 (2 ft-lamberts). Measure any adjacent dark squares. The contrast ratio is the bright square value divided by the dark square value. *Note 1. — During contrast ratio testing, FSTD aft-cab and flight deck ambient light*

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
									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.*
4.a.6	Light point contrast ratio.	Not less than 25:1.	Not applicable.				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. — 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. — During contrast ratio testing, FSTD aft-cab and flight deck ambient light levels should be as low as practical.*
	Light point contrast ratio.	Not less than 10:1.	Not applicable.		X	X			
4.a.7	Light point brightness.	Not less than 30 cd/m^2 (8.8 ft-lamberts).	Not applicable.				X	X	Light points should be displayed as a matrix creating a square.

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
									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.				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 < 0.015 cd/m^2 (0.004 ft-lamberts). Sequential contrast: Maximum brightness – (Background brightness – Black polygon brightness) > 2 000:1.	Not applicable.		X	X	X	X	The light meter should be mounted in a fixed position viewing the forward center area of each display. All projectors should be turned off and the cockpit environment made as dark as possible. A background reading should be taken of the remaining ambient light on the screen. The projectors should then be turned on and a black polygon displayed. A second reading should then be taken and the difference between this and the ambient level recorded.

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
									A full brightness white polygon should then be measured for the sequential contrast test. This test is generally only required for **light valve projectors**. An SOC should be provided if the test is not run, stating why.
4.a.10	Motion blur.	When a pattern is rotated about the eyepoint at 10°/s, the smallest detectable gap 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. 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 NSPM should be consulted on the limitations.*

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
									This test is generally only required for **light valve projectors**. An SOC should be provided if the test is not run, stating why.
4.a.11	Speckle test.	Speckle contrast must be < 10%.	Not applicable.	An SOC is required describing the test method.	X	X	X	X	This test is generally only required for **laser projectors**. An SOC should be provided if the test is not run, stating why.
4.b	**Head-Up Display (HUD)**								
4.b.1	Static Alignment.	Static alignment with displayed image. HUD bore sight must align with the center of the displayed image spherical pattern. Tolerance +/- 6 arc min.			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.2	System display.	All functionality in all flight modes must be demonstrated.			X	X	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	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	Takeoff point and on approach at 200 ft.		X	X	X	X	*Note.— The effects of the alignment tolerance in 4.b.1 should be taken into account.*

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		typical of the aircraft and system type.							
4.c.2	EFVS RVR and visibility calibration.	The scene represents the EFVS view at 350 m (1200 ft) and 1609 m (1 sm) RVR including correct light intensity.	Flight.		X	X	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	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: ±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 airplane'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 be described and included in the slant range visibility calculation used in the VGS computation.*	X	X	X	X	Pre-position for this test is encouraged but may be achieved via manual or autopilot control to the desired position.
4.e	**Visual System Capacity**								
4.e.1	System capacity – Day mode.	Not less than: 10 000 visible textured surfaces, 6 000 light	Not applicable.				X	X	Demonstrated through use of a visual scene rendered with the same image generator

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Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		points, 16 moving models.							modes used to produce scenes for training. The required surfaces, light points, and moving models should be displayed simultaneously.
4.e.2	System capacity – Twilight/night mode.	Not less than: 10 000 visible textured surfaces, 15 000 light points, 16 moving models.	Not applicable.				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 should be displayed simultaneously.
5. Sound System. The sponsor will not be required to repeat the airplane 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 airplane 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 airplane tests. If the airplane tests are repeated during continuing qualification evaluations, the results may be compared against initial qualification evaluation results or airplane 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 airplane data set. The airplane and flight simulator results must be produced using comparable data analysis techniques.									

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
5.a.	**Turbo-jet airplanes.**								All tests in this section should be presented using an unweighted 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 7 of this Attachment
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	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.	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three	Ground.	Normal condition prior to takeoff.				X	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,

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.							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.3.	All engines at maximum allowable thrust with brakes set.	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.	Ground.	Normal condition prior to takeoff.				X	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.4.	Climb	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.	En-route climb.	Medium altitude.				X	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

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
									tolerances should be used during recurrent evaluations.
5.a.5.	Cruise	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.	Cruise.	Normal cruise configuration.				X	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.6.	Speed brake/spoilers extended (as appropriate).	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.	Cruise.	Normal and constant speed brake deflection for descent at a constant airspeed and power setting.				X	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.7	Initial approach.	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three	Approach.	Constant airspeed, gear up, flaps/slats as appropriate.				X	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,

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.							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.8	Final approach.	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.	Landing.	Constant airspeed, gear down, landing configuration flaps.				X	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

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
5.b	**Propeller-driven airplanes**								All tests in this section should be presented using an unweighted 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 3.7 of this Appendix.
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	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.	Initial evaluation: ± 5 dB per 1/3 octave band.	Ground.	Normal condition prior to takeoff.				X	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

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		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.							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.3.	Ground idle or equivalent.	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.	Ground.	Normal condition prior to takeoff.				X	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.4	Flight idle or equivalent.	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results	Ground.	Normal condition prior to takeoff.				X	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

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		cannot exceed 2 dB.							tolerances should be used during recurrent evaluations.
5.b.5	All engines at maximum allowable power with brakes set.	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.	Ground.	Normal condition prior to takeoff.				X	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.6	Climb.	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.	En-route climb.	Medium altitude.				X	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.7	Cruise	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when	Cruise.	Normal cruise configuration.				X	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.

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.							Where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.
5.b.8	Initial approach.	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.	Approach.	Constant airspeed, gear up, flaps extended as appropriate, RPM as per operating manual.				X	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.9	Final approach.	Initial evaluation: ± 5 dB per 1/3 octave band. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.	Landing.	Constant airspeed, gear down, landing configuration flaps, RPM as per operating manual.				X	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.c.	**Special cases.**	Initial evaluation: ± 5 dB per 1/3 octave	As appropriate.					X	This applies to special steady-state cases identified as

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		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.							particularly significant to the pilot, important in training, or unique to a specific airplane type or model. 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.d	**FSTD background noise**	Initial evaluation: background noise levels must fall below the sound levels described in Paragraph 7.c (5) of this Attachment. 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 NSPM. 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 7 of this Attachment. This test should be presented using an unweighted 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						X	Only required if the results are to be used during continuing qualification evaluations in lieu of airplane tests.

Table A2A

Full Flight Simulator (FFS) Objective Tests									
QPS REQUIREMENTS									INFORMATION
Test		Tolerance	Flight Conditions	Test Details	Simulator Level				Notes
Entry Number	Title				A	B	C	D	
		consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.							The results must be approved by the NSPM during the initial qualification. This test should be presented using an unweighted 1/3 octave band format from band 17 to 42 (50 Hz to 16 kHz).
6	**SYSTEMS INTEGRATION**								
6.a.	**System response time**								
6.a.1	Transport delay.	100 milliseconds or less after controller movement.	Pitch, roll and yaw.				X	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.— The delay from the airplane EFVS electronic elements should be added to the 30 ms tolerance before comparison with visual system reference as described in Attachment G of this Part.*
	Transport delay.	300 milliseconds or less after controller movement.	Pitch, roll and yaw.		X	X			

Begin Information

3. General

a. 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 test near the ground.

b. The reader is encouraged to review the Airplane Flight Simulator Evaluation Handbook, Volumes I and II, published by the Royal Aeronautical Society, London, UK, and AC 25–7, as amended, Flight Test Guide for Certification of Transport Category Airplanes, and AC 23–8, as amended, Flight Test Guide for Certification of Part 23 Airplanes, for references and examples regarding flight testing requirements and techniques.

4. Control Dynamics

a. General. The characteristics of an airplane flight control system have a major effect on handling qualities. A significant consideration in pilot acceptability of an airplane is the ''feel'' provided through the flight controls. Considerable effort is expended on airplane feel system design so that pilots will be comfortable and will consider the airplane desirable to fly. In order for an FFS to be representative, it should ''feel'' like the airplane being simulated. Compliance with this requirement is determined by comparing a recording of the control feel dynamics of the FFS to actual airplane measurements in the takeoff, cruise and landing configurations.

(1) Recordings such as free response to an impulse or step function are classically used to estimate the dynamic properties of electromechanical systems. In any case, it is only possible to estimate the dynamic properties as a result of being able to estimate true inputs and responses. Therefore, it is imperative that the best possible data be collected since close matching of the FFS control loading system to the airplane system is essential. The required dynamic control tests are described in Table A2A of this attachment.

(2) For initial and upgrade evaluations, the QPS requires that control dynamics characteristics be measured and recorded directly from the flight controls (Handling Qualities—Table A2A). 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 in the takeoff, cruise and landing flight conditions and configurations.

(3) For airplanes 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 airplanes, takeoff, cruise, and landing configurations have like effects. Thus, one may suffice for another. In either case, engineering validation or airplane manufacturer rationale should be submitted as justification for ground tests or for eliminating a configuration. 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.

b. Control Dynamics Evaluation. The dynamic properties of control systems are often stated in terms of frequency, damping and a number of other classical measurements. 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:

(1) For Level C and D simulators. Tests to verify that control feel dynamics represent the airplane should show that the dynamic damping cycles (free response of the controls) match those of the airplane within specified tolerances. The NSPM recognizes that several different testing methods may be used to verify the control feel dynamic response. The NSPM 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:

(a) Underdamped response. Two measurements are required for the period, the time to first zero crossing (in case a rate limit is present) and the subsequent frequency of oscillation. It is necessary to measure cycles on an individual basis in case there are non-uniform periods in the response. Each period will be independently compared to the respective period of the airplane 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 per cent of the total initial displacement should be considered. The residual band, labeled $T(A_d)$ on Figure A2A 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 airplane data, the process should begin by overlaying or aligning the FFS and airplane 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 airplane data. The procedure for evaluating the response is illustrated in Figure A2A.

(b) 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 airplane within ±10 percent. Figure A2B illustrates the procedure.

(c) 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.

(2) Tolerances.

(a) The following table summarizes the tolerances, T, for underdamped systems, and ''n'' is the sequential period of a full cycle of oscillation. See Figure A2A of this attachment for an illustration of the referenced measurements.

$T(P_0)$ ±10% of P_0
$T(P_1)$ ±20% of P_1
$T(P_2)$ ±30% of P_2
$T(P_n)$ ±10(n+1)% of P_n
$T(A_n)$ ±10% of A_1
$T(A_d)$ ±5% of A_d = residual band
Significant overshoots First overshoot and ±1 subsequent overshoots

(b) The following tolerance applies to critically damped and overdamped systems only. See Figure A2B for an illustration of the reference measurements:

$T(P_0)$ ±10% of P_0

End Information

Begin QPS Requirement

c. Alternative method for control dynamics evaluation.

(1) An alternative means for validating control dynamics for aircraft with hydraulically powered flight controls and artificial feel systems is by the measurement of control force and rate of movement. For each axis of pitch, roll, and yaw, the control must be forced to its maximum extreme position for the following distinct rates. These tests are conducted under normal flight and ground conditions.

(a) Static test—Slowly move the control so that a full sweep is achieved within 95 to 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.

(b) Slow dynamic test—Achieve a full sweep within 8–12 seconds.

(c) Fast dynamic test—Achieve a full sweep within 3–5 seconds.

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

(d) Tolerances

(i) Static test; see Table A2A, FFS Objective Tests, Entries 2.a.1., 2.a.2., and 2.a.3.

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

End QPS Requirement

Begin Information

d. The FAA is open to alternative means such as the one described above. The alternatives should be justified and appropriate to the application. For example, the method described here may not apply to all manufacturers' systems and certainly not to aircraft with reversible control systems. Each case is considered on its own merit on an ad hoc basis. If the FAA finds that alternative methods do not result in satisfactory performance, more conventionally accepted methods will have to be used.

BILLING CODE 4910–13–P

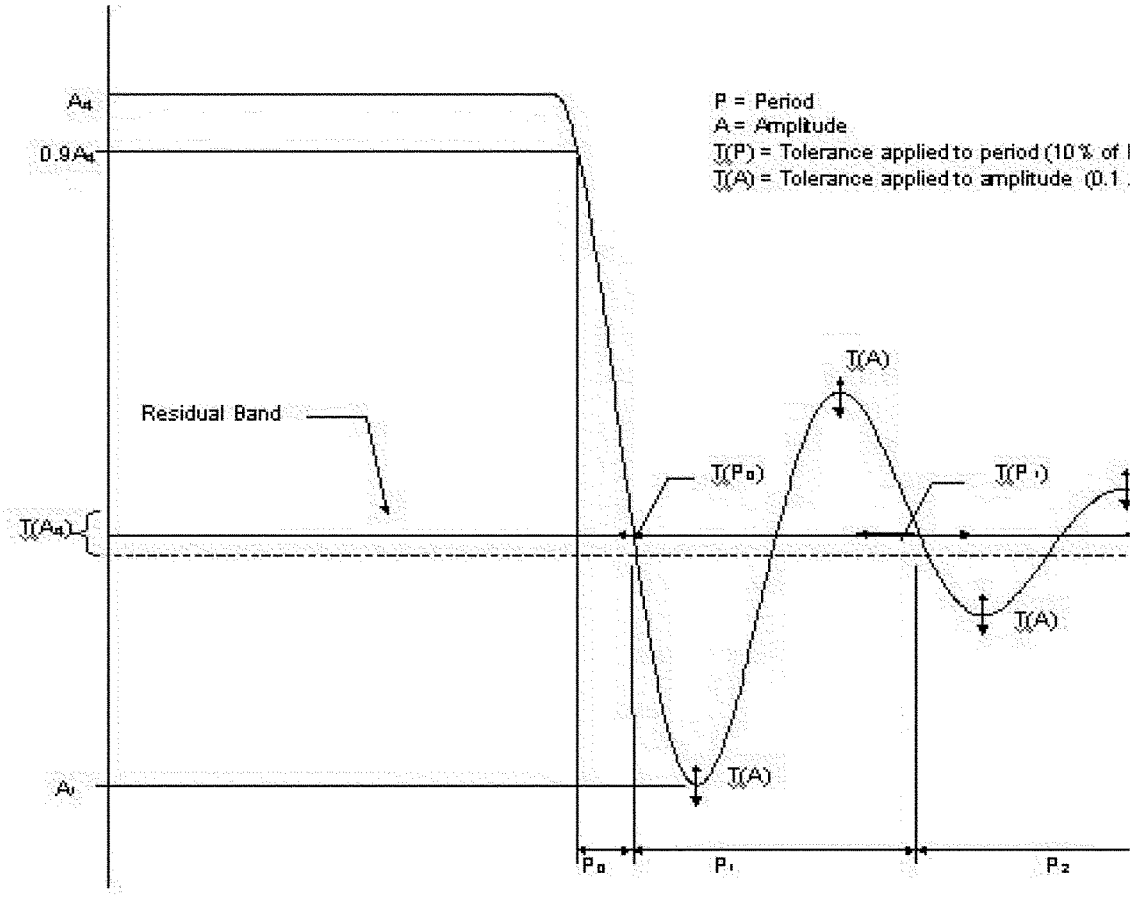


Figure A2A
Underdamped Step Response

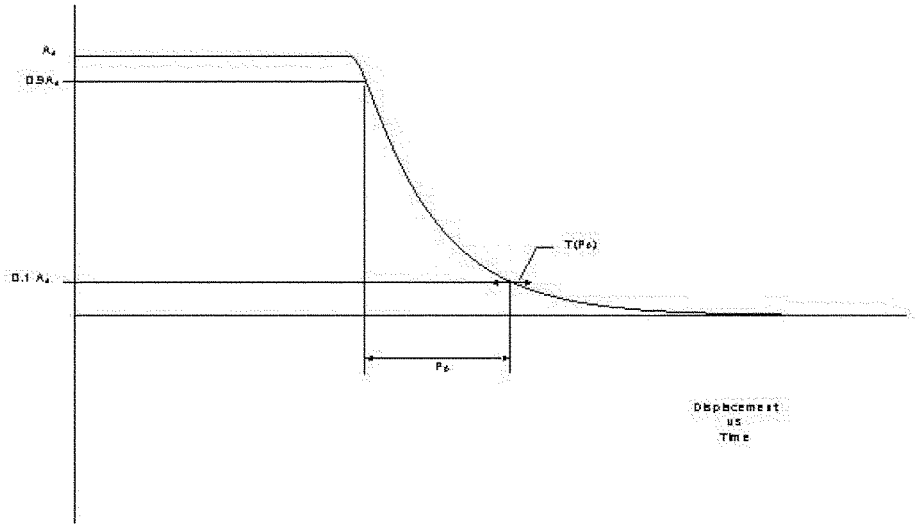


Figure A2B
Critically and Overdamped Step Response

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5. Ground Effect

a. For an FFS to be used for take-off and landing (not applicable to Level A simulators in that the landing maneuver may not be credited in a Level A simulator) it should reproduce the aerodynamic changes that occur in ground effect. The parameters

chosen for FFS validation should indicate these changes.

(1) A dedicated test should be provided that will validate the aerodynamic ground effect characteristics.

(2) 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.

b. The NSPM 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:

(1) 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).

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

c. The lateral-directional characteristics are also altered by ground effect. For example, because of changes in lift, roll damping is affected. The change in roll damping will affect other dynamic modes usually evaluated for 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.

6. Motion System

a. General.

(1) Pilots use continuous information signals to regulate the state of the airplane. In concert with the instruments and outside-world visual information, whole-body motion feedback is essential in assisting the pilot to control the airplane dynamics, particularly in the presence of external disturbances. 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 airplane during a prescribed minimum set of maneuvers and conditions. The response of the motion cueing system should also be repeatable.

(2) The Motion System tests in Section 3 of Table A2A 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, 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.

b. Motion System Checks. The intent of test 3a, Frequency Response, test 3b, Leg Balance, and test 3c, Turn-Around Check, as described in the Table of Objective Tests, is to demonstrate the performance of the motion system hardware, and to check the integrity of the motion set-up with regard to calibration and wear. These tests are independent of the motion cueing software and should be considered robotic tests.

c. 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.

(1) Input: The inputs should be such that rotational accelerations, rotational rates, and linear accelerations are inserted before the transfer from airplane 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.

(2) Recommended output:

(a) Actual platform linear accelerations; the output will comprise accelerations due to both the linear and rotational motion acceleration;

(b) Motion actuators position.

d. Objective Motion Cueing Test—Frequency Domain

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

(2) Frequency response test. This test requires the frequency response to be measured for the motion cueing system. Reference sinusoidal signals are inserted at the pilot reference position prior to the motion cueing computations. The response of the motion platform in the corresponding degree-of-freedom (the direct transfer relations), as well as the motions resulting from cross-coupling (the cross-coupling relations), are recorded. These are the tests that are important to pilot motion cueing and are general tests applicable to all types of airplanes. These tests can be run at any time deemed acceptable to the NSPM prior to and/or during the initial qualification.

(3) Transfer Functions. The frequency responses describe the relations between aircraft motions and simulator motions. The relations are explained below per individual test. Tests 1, 3, 5, 6, 8 and 10 show the direct transfer relations, while tests 2, 4, 7 and 9 show the cross-coupling relations.

1. FSTD pitch response to aircraft pitch input
2. FSTD surge specific force response due to aircraft pitch input
3. FSTD roll response to aircraft roll input
4. FSTD sway specific force response due to aircraft roll input
5. FSTD yaw response to aircraft yaw input
6. FSTD surge specific force response to aircraft surge input
7. FSTD pitch rate and pitch acceleration response to aircraft surge input
8. FSTD sway specific force response to aircraft sway input
9. FSTD roll rate and pitch acceleration response to aircraft sway input
10. FSTD heave specific force response to aircraft heave input

(4) Frequency Range. The tests should be conducted by introducing sinusoidal inputs at discrete input frequencies entered at the output of the flight model, transformed to the pilot reference position just before the motion cueing computations, and measured at the response of the FSTD platform. For each relation defined in section (3), measurements must be taken in at least 12 discrete frequencies within a range of 0.0159 and 2.515 Hz.

(5) Input Signal Amplitude. The tests applied here to the motion cueing system are intended to qualify its response to normal control inputs during maneuvering (i.e. not aggressive or excessively hard control inputs). It is necessary to excite the system in such a manner that the response is measured with a high signal-to-noise ratio,

and that the possible non-linear elements in the motion cueing system are not overly excited.

(6) Presentation of Results. The measured modulus and phase should be tabulated for the twelve frequencies and for each of the transfer relations given section (3). The results should also be plotted for each component in a modulus versus phase plot. The modulus should range from 0.0 to 1.0 along the horizontal axis, and the absolute value of the phase from 0 to 180 degrees along the vertical axis. An example is shown in Figure A2C.

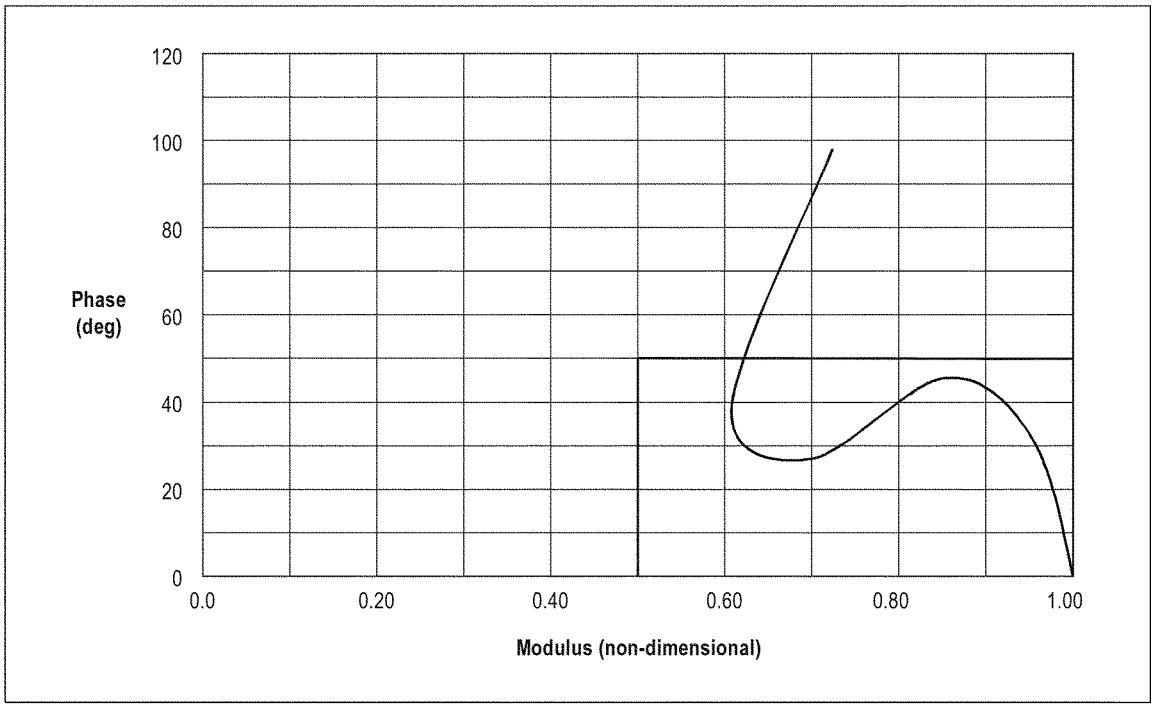


Figure A2C Example plot of frequency response test of a motion cueing system. The frequency varies along the curved line.

e. Motion Vibrations.

(1) Presentation of results. The characteristic motion vibrations may be used to verify that the flight simulator can reproduce the frequency content of the airplane 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 airplane 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 airplane 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.

(2) Interpretation of results. The overall trend of the PSD plot should be considered while focusing on the dominant frequencies. Less emphasis should be placed on the differences at the high frequency and low amplitude portions of the PSD plot. During the analysis, 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 airplane 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-rms^2/Hz would describe a heavy buffet and may be seen in the deep stall regime. Alternatively, a 1×10^{-6} g-rms^2/Hz buffet is almost not perceivable; but may represent a flap buffet at low speed. The previous two examples differ in magnitude by 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-rms^2 is the mathematical expression for ''g's root mean squared.''

7. Sound System

a. General. The total sound environment in the airplane is very complex, and changes with atmospheric conditions, airplane 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 comparable to those of the airplane. 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 this attachment were selected to provide a representative sample of normal static conditions typically experienced by a pilot.

b. Alternate propulsion. For FFS with multiple propulsion configurations, any condition listed in Table A2A of this attachment should be presented for evaluation as part of the QTG if identified by the airplane manufacturer or other data supplier as significantly different due to a change in propulsion system (engine or propeller).

c. Data and Data Collection System.

(1) Information provided to the flight simulator manufacturer should 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.

(2) The system used to perform the tests listed in Table A2A should comply with the following standards:

(a) The specifications for octave, half octave, and third octave band filter sets may be found in American National Standards Institute (ANSI) S1.11–1986;

(b) Measurement microphones should be type WS2 or better, as described in International Electrotechnical Commission (IEC) 1094–4–1995.

(3) Headsets. If headsets are used during normal operation of the airplane they should also be used during the flight simulator evaluation.

(4) Playback equipment. Playback equipment and recordings of the QTG conditions should be provided during initial evaluations.

(5) Background noise.

(a) Background noise is the noise in the flight simulator that is not associated with the airplane, 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 airplane sounds and should be kept below the airplane sounds. In some cases, the sound level of the simulation can be increased to compensate for the background noise. However, this approach is limited by the specified tolerances and by the subjective acceptability of the sound environment to the evaluation pilot.

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

(i) 70 dB @ 50 Hz;

(ii) 55 dB @ 1000 Hz;

(iii) 30 dB @ 16 kHz

(Note: These limits are for unweighted 1/3 octave band sound levels. Meeting these limits for background noise does not ensure an acceptable flight simulator. Airplane sounds that fall below this limit require careful review and may require lower limits on background noise.)

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

(a) Variation of data between tail numbers;

(b) Frequency response of microphones;

(c) Repeatability of the measurements.

TABLE A2B—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
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		1.1

8. Additional Information About Flight Simulator Qualification for New or Derivative Airplanes

a. Typically, an airplane manufacturer's approved final data for performance, handling qualities, systems or avionics is not available until well after a new or derivative airplane has entered service. However, flight crew training and certification often begins several months prior to the entry of the first airplane into service. Consequently, it may be necessary to use preliminary data provided by the airplane manufacturer for interim qualification of flight simulators.

b. In these cases, the NSPM may accept certain partially validated preliminary airplane and systems data, and early release ('red label') avionics data in order to permit the necessary program schedule for training, certification, and service introduction.

c. Simulator sponsors seeking qualification based on preliminary data should consult the NSPM to make special arrangements for using preliminary data for flight simulator qualification. The sponsor should also consult the airplane and flight simulator manufacturers to develop a data plan and flight simulator qualification plan.

d. The procedure to be followed to gain NSPM acceptance of preliminary data will vary from case to case and between airplane manufacturers. Each airplane manufacturer's new airplane development and test program is designed to suit the needs of the particular project and may not contain the same events or sequence of events as another manufacturer's program, or even the same manufacturer's program for a different airplane. Therefore, there cannot be a prescribed invariable procedure for acceptance of preliminary data, but instead there should be a statement describing the final sequence of events, data sources, and validation procedures agreed by the simulator sponsor, the airplane manufacturer, the flight simulator manufacturer, and the NSPM.

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.

e. 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:

(1) Manufacturer's engineering report. The report should explain the predictive method used and illustrate past success of the method on similar projects. For example, the manufacturer could show the application of the method to an earlier airplane model or predict the characteristics of an earlier model and compare the results to final data for that model.

(2) 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.

f. 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 NSPM, the simulator sponsor, and the airplane manufacturer. When applying for interim qualification using preliminary data, the simulator sponsor and the NSPM 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.

g. Flight simulator avionics should stay essentially 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 between the simulator sponsor and the NSPM. Consultation with the flight simulator manufacturer is desirable throughout the qualification process.

h. The following describes an example of the design data and sources that might be used in the development of an interim qualification plan.

(1) The plan should consist of the development of a QTG based upon a mix of flight test and engineering simulation data. For data collected from specific 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.

(2) 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:

(a) Propulsion
(b) Aerodynamics;
(c) Mass properties;
(d) Flight controls;
(e) Stability augmentation; and
(f) Brakes/landing gear.

i. A qualified test pilot should be used to assess handling qualities and performance evaluations for the qualification of flight simulators of new airplane types.

End Information

Begin QPS Requirement

9. Engineering Simulator—Validation Data

a. When a fully validated simulation (i.e., validated with flight test results) is modified due to changes to the simulated airplane configuration, the airplane manufacturer or other acceptable data supplier must coordinate with the NSPM if they propose to supply validation data from an ''audited'' engineering simulator/simulation to selectively supplement flight test data. The NSPM must be provided an opportunity to audit the engineering simulation or the engineering simulator used to generate the validation data. Validation data from an audited engineering simulation 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.

b. Airplane 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 NSPM and provide the following:

(1) 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 a description of the actual simulation model modifications that includes a step-by-step description leading from the original model(s) to the current model(s).

(2) A schedule for review by the NSPM of the proposed plan and the subsequent validation data to establish acceptability of the proposal.

(3) Validation data from an audited engineering simulator/simulation to supplement specific segments of the flight test data.

c. To be qualified to supply engineering simulator validation data, for aerodynamic, engine, flight control, or ground handling models, an airplane manufacturer or other acceptable data supplier must:

(1) Be able to verify their ability able to:

(a) Develop and implement high fidelity simulation models; and

(b) Predict the handling and performance characteristics of an airplane with sufficient accuracy to avoid additional flight test activities for those handling and performance characteristics.

(2) Have an engineering simulator that:

(a) Is a physical entity, complete with a flight deck representative of the simulated class of airplane;

(b) Has controls sufficient for manual flight;

(c) Has models that run in an integrated manner;

(d) Has fully flight-test validated simulation models as the original or baseline simulation models;

(e) Has an out-of-the-flight deck visual system;

(f) Has actual avionics boxes interchangeable with the equivalent software simulations to support validation of released software;

(g) Uses the same models as released to the training community (which are also used to produce stand-alone proof-of-match and checkout documents);

(h) Is used to support airplane development and certification; and

(i) Has been found to be a high fidelity representation of the airplane by the manufacturer's pilots (or other acceptable data supplier), certificate holders, and the NSPM.

(3) Use the engineering simulator/simulation to produce a representative set of integrated proof-of-match cases.

(4) Use a configuration control system covering hardware and software for the operating components of the engineering simulator/simulation.

(5) Demonstrate that the predicted effects of the change(s) are within the provisions of sub-paragraph ''a'' of this section, and confirm that additional flight test data are not required.

d. Additional Requirements for Validation Data

(1) When used to provide validation data, an engineering simulator must meet the simulator standards currently applicable to training simulators except for the data package.

(2) The data package used must be:

(a) Comprised of the engineering predictions derived from the airplane design, development, or certification process;

(b) Based on acceptable aeronautical principles with proven success history and valid outcomes for aerodynamics, engine operations, avionics operations, flight control applications, or ground handling;

(c) Verified with existing flight-test data; and

(d) Applicable to the configuration of a production airplane, as opposed to a flight-test airplane.

(3) Where engineering simulator data are used as part of a QTG, an essential match must exist between the training simulator and the validation data.

(4) 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 ICAO Document 9625, the ''Manual of Criteria for the Qualification of Flight Simulators.''

End QPS Requirement

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10. [Reserved]

11. Validation Test Tolerances

Begin Information

a. Non-Flight-Test Tolerances

(1) If engineering simulator data or other non-flight-test data are used as an allowable form of reference validation data for the objective tests listed in Table A2A of this attachment, the data provider must supply a well-documented mathematical model and testing procedure that enables a replication of the engineering simulation results within 40% of the corresponding flight test tolerances.

b. Background

(1) The tolerances listed in Table A2A of this attachment are designed to measure the quality of the match using flight-test data as a reference.

(2) Good engineering judgment should be applied to all tolerances in any test. A test is failed when the results clearly fall outside of the prescribed tolerance(s).

(3) Engineering simulator data are acceptable because the same simulation models used to produce the reference data are also used to test the flight training simulator (i.e., the two sets of results should be ''essentially'' similar).

(4) The results from the two sources may differ for the following reasons:

(a) Hardware (avionics units and flight controls);

(b) Iteration rates;

(c) Execution order;

(d) Integration methods;

(e) Processor architecture;

(f) Digital drift, including:

(i) Interpolation methods;

(ii) Data handling differences; and

(iii) Auto-test trim tolerances.

(5) The tolerance limit between the reference data and the flight simulator results is generally 40% of the corresponding 'flight-test' tolerances. However, there may be cases where the simulator models used are of higher fidelity, or the manner in which they are cascaded in the integrated testing loop have the effect of a higher fidelity, than those supplied by the data provider. Under these circumstances, it is possible that an error greater than 20% may be generated. An error greater than 40% may be acceptable if simulator sponsor can provide an adequate explanation.

(6) Guidelines are needed for the application of tolerances to engineering-simulator-generated validation data because:

(a) Flight-test data are often not available due to technical reasons;

(b) Alternative technical solutions are being advanced; and

(c) High costs.

12. Validation Data Roadmap

a. Airplane manufacturers or other data suppliers should supply a validation data roadmap (VDR) document as part of the data package. A VDR document contains guidance material from the airplane validation data supplier recommending the best possible sources of data to be used as validation data in the QTG. A VDR is of special value when requesting interim qualification, qualification of simulators for airplanes certificated prior to 1992, and qualification of alternate engine or avionics fits. A sponsor seeking to have a device qualified in accordance with the standards contained in this QPS appendix should submit a VDR to the NSPM as early as possible in the planning stages. The NSPM is the final authority to approve the data to be used as validation material for the QTG. The NSPM and the Joint Aviation Authorities' Synthetic Training Devices Advisory Board have committed to maintain a list of agreed VDRs.

b. The VDR should identify (in matrix format) sources of data for all required tests. It should also provide guidance regarding the validity of these data for a specific engine type, thrust rating configuration, and the revision levels of all avionics affecting airplane handling qualities and performance. The VDR should include rationale or explanation in cases where data or parameters are missing, engineering simulation data are to be used, flight test methods require explanation, or there is any deviation from data requirements. Additionally, the document should refer to other appropriate sources of validation data (e.g., sound and vibration data documents).

c. The Sample Validation Data Roadmap (VDR) for airplanes, shown in Table A2C, depicts a generic roadmap matrix identifying sources of validation data for an abbreviated list of tests. This document is merely a sample and does not provide actual data. A complete matrix should address all test conditions and provide actual data and data sources.

d. Two examples of rationale pages are presented in Appendix F of the IATA ''Flight Simulator Design and Performance Data Requirements.'' These illustrate the type of airplane and avionics configuration information and descriptive engineering rationale used to describe data anomalies or provide an acceptable basis for using alternative data for QTG validation requirements.

End Information

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Table A2C - Sample Validation Data Roadmap for Airplanes

ICAO or IATA #	Test Description		Validation Source		Validation Document						Comments
Notes: 1. Only one page is shown; and some test conditions were deleted for brevity. 2. Relevant regulatory material should be consulted and all applicable tests addressed. 3. Validation source, document and comments provided herein are for reference only and do not constitute approval for use. 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.		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	*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)	**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)				**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**						
1.e.1.a.	Stopping Time & Distance (Wheel brakes / Light weight).			**X**	**D71**					(d73)	No flight test data available; see rationale.
1.e.1.b.	Stopping Time & Distance (Wheel brakes/ Med. weight).		**X**	(x)	**D71**					(d73)	
1.e.1.c.	Stopping Time & Distance (Wheel brakes / Heavy weight).		**X**	(x)	**D71**					(d73)	
1.e.2.a.	Stopping Time & Distance (Reverse thrust / Light weight).		**X**	(x)	**D71**					(d73)	
1.e.2.b.	Stopping Time & Distance (Reverse thrust / Med. Weight).			**X**	(d71)					**D73**	No flight test data available; see rationale.

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Begin Information

13. Acceptance Guidelines for Alternative Engines Data

a. Background

(1) For a new airplane type, the majority of flight validation data are collected on the first airplane configuration with a ''baseline'' engine type. These data are then used to validate all flight simulators representing that airplane type.

(2) Additional flight test validation data may be needed for flight simulators representing an airplane with engines of a different type than the baseline, or for engines with thrust rating that is different from previously validated configurations.

(3) When a flight simulator with alternate engines is to be qualified, the QTG should contain tests against flight test validation data for selected cases where engine differences are expected to be significant.

b. Approval Guidelines For Validating Alternate Engine Applications

(1) The following guidelines apply to flight simulators representing airplanes with alternate engine applications or with more than one engine type or thrust rating.

(2) Validation tests can be segmented into two groups, those that are dependent on engine type or thrust rating and those that are not.

(3) For tests that are independent of engine type or thrust rating, the QTG 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.

(4) For tests that are affected by engine type, the QTG should contain selected engine-specific flight test data sufficient to validate that particular airplane-engine configuration. These effects may be due to engine dynamic characteristics, thrust levels or engine-related airplane configuration changes. This category is primarily characterized by variations between different engine manufacturers' products, but also includes differences due to significant engine design changes from a previously flight-validated configuration within a single engine type. See Table A2D, Alternate Engine Validation Flight Tests in this section for a list of acceptable tests.

(5) Alternate engine validation data should be based on flight test data, except as noted in sub-paragraphs 13.c.(1) and (2), or where other data are specifically allowed (e.g., engineering simulator/simulation data). If certification of the flight characteristics of the airplane with a new thrust rating (regardless of percentage change) does require certification flight testing with a comprehensive stability and control flight instrumentation package, then the conditions described in Table A2D in this section should be obtained from flight testing and presented in the QTG. Flight test data, other than throttle calibration data, are not required if the new thrust rating is certified on the airplane without need for a comprehensive stability and control flight instrumentation package.

(6) As a supplement to the engine-specific flight tests listed in Table A2D 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 NSPM should agree in advance on the specific validation tests to be supported by engineering simulation data.

(7) A matrix or VDR should be provided with the QTG indicating the appropriate validation data source for each test.

(8) The flight test conditions in Table A2D are appropriate and should be sufficient to validate implementation of alternate engines in a flight simulator.

End Information

Begin QPS Requirement

c. Test Requirements

(1) 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 A2D for a list of acceptable tests.

(2) 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 airplane's flight characteristics.

(3) 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 airplane or engineering test bench with the correct engine controller (both hardware and software) are required.

End QPS Requirement

Begin QPS Requirement

TABLE A2D—ALTERNATIVE ENGINE VALIDATION FLIGHT TESTS

Entry No.	Test description		Alternative engine type	Alternative thrust rating [2]
1.b.1.	Normal take-off/ground acceleration time and distance		X	X
1.b.4. 1.b.2.	$V_{mcg,}$ if performed for airplane certification		X	X
1.b.5. 1.b.8.	Engine-out take-off Dynamic engine failure after take-off	Either test may be performed.	X	
1.b.7. 1.d.1.	Rejected take-off if performed for airplane certification Cruise performance		X X	
1.f.1. 1.f.2.	Engine acceleration and deceleration		X	X
2.a.8.	Throttle calibration [1]		X	X
2.c.1.	Power change dynamics (acceleration)		X	X
2.d.1.	V_{mca} if performed for airplane certification		X	X
2.d.5.	Engine inoperative trim		X	X
2.e.1.	Normal landing		X	

[1] Must be provided for all changes in engine type or thrust rating; see paragraph 13.c.(3).
[2] See paragraphs 13.c.(1) through13.c.(3), for a definition of applicable thrust ratings.

End QPS Requirement

Begin Information

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

a. Background

(1) For a new airplane type, the majority of flight validation data are collected on the first airplane configuration with a ''baseline'' flight-related avionics ship-set; (see subparagraph b.(2) of this section). These data are then used to validate all flight simulators representing that airplane type.

(2) Additional validation data may be required for flight simulators representing an airplane with avionics of a different hardware design than the baseline, or a different software revision than previously validated configurations.

(3) When a flight simulator with additional or alternate avionics configurations is to be qualified, the QTG should contain tests against validation data for selected cases where avionics differences are expected to be significant.

b. Approval Guidelines For Validating Alternate Avionics

(1) The following guidelines apply to flight simulators representing airplanes with a revised avionics configuration, or more than one avionics configuration.

(2) The baseline validation data should be based on flight test data, except where other data are specifically allowed (e.g., engineering flight simulator data).

(3) The airplane avionics can be segmented into two groups, systems or components whose functional behavior contributes to the aircraft response presented in the QTG results, and systems that do not. The following avionics are examples of contributory systems for which hardware design changes or software revisions may lead to significant differences in the aircraft response relative to the baseline avionics configuration: Flight control computers and controllers for engines, autopilot, braking system, nosewheel steering system, and high lift system. Related avionics such as stall warning and augmentation systems should also be considered.

(4) The acceptability of validation data used in the QTG for an alternative avionics fit should be determined as follows:

(a) For changes to an avionics system or component that do not affect QTG validation test response, the QTG test can be based on validation data from the previously validated avionics configuration.

(b) For an avionics change to a contributory system, where a specific test is not affected by the change (e.g., the avionics change is a Built In Test Equipment (BITE) update or a modification in a different flight phase), the QTG test can be based on validation data from the previously-validated avionics configuration. The QTG should include authoritative justification (e.g., from the airplane manufacturer or system supplier) that this avionics change does not affect the test.

(c) For an avionics change to a contributory system, the QTG may be based on validation data from the previously-validated avionics configuration if no new functionality is added and the impact of the avionics change on the airplane response is small and based on acceptable aeronautical principles with proven success history and valid outcomes. This should be supplemented with avionics-specific validation data from the airplane manufacturer's engineering simulation, generated with the revised avionics configuration. The QTG should also include an explanation of the nature of the change and its effect on the airplane response.

(d) For an avionics change to a contributory system that significantly affects some tests in the QTG or where new functionality is added, the QTG should be based on validation data from the previously validated avionics configuration and supplemental avionics-specific flight test data sufficient to validate the alternate avionics revision. 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 airplane manufacturer should coordinate flight simulator data requirements, in advance with the NSPM.

(5) A matrix or ''roadmap'' should be provided with the QTG indicating the appropriate validation data source for each test. The roadmap should include identification of the revision state of those contributory avionics systems that could affect specific test responses if changed.

15. Transport Delay Testing

a. This paragraph explains how to determine the introduced transport delay through the flight simulator system so that it does not exceed a specific time delay. 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. The transport delay should not exceed the maximum allowable interval.

b. Four specific examples of transport delay are:

(1) Simulation of classic non-computer controlled aircraft;

(2) Simulation of computer controlled aircraft using real airplane black boxes;

(3) Simulation of computer controlled aircraft using software emulation of airplane boxes;

(4) Simulation using software avionics or re-hosted instruments.

c. Figure A2D illustrates the total transport delay for a non-computer-controlled airplane or the classic transport delay test. Since there are no airplane-induced delays for this case, the total transport delay is equivalent to the introduced delay.

d. Figure A2E illustrates the transport delay testing method using the real airplane controller system.

e. To obtain the induced transport delay for the motion, instrument and visual signal, the delay induced by the airplane controller should be subtracted from the total transport delay. This difference represents the introduced delay and should not exceed the standards prescribed in Table A1A.

f. Introduced transport delay is measured from the flight deck control input to the reaction of the instruments and motion and visual systems (See Figure A2D).

g. The control input may also be introduced after the airplane controller system and the introduced transport delay measured directly from the control input to the reaction of the instruments, and simulator motion and visual systems (See Figure A2E).

h. Figure A2F illustrates the transport delay testing method used on a flight simulator that uses a software emulated airplane controller system.

i. It is not possible to measure the introduced transport delay using the simulated airplane controller system architecture for the pitch, roll and yaw axes. Therefore, the signal should be measured directly from the pilot controller. The flight simulator manufacturer should measure the total transport delay and subtract the inherent delay of the actual airplane components because the real airplane controller system has an inherent delay provided by the airplane manufacturer. The flight simulator manufacturer should ensure that the introduced delay does not exceed the standards prescribed in Table A1A.

j. Special measurements for instrument signals for flight simulators using a real airplane instrument display system instead of a simulated or re-hosted display. For flight instrument systems, the total transport delay should be measured and the inherent delay of the actual airplane components subtracted to ensure that the introduced delay does not exceed the standards prescribed in Table A1A.

(1) Figure A2GA illustrates the transport delay procedure without airplane display simulation. The introduced delay consists of the delay between the control movement and the instrument change on the data bus.

(2) Figure A2GB illustrates the modified testing method required to measure introduced delay due to software avionics or re-hosted instruments. The total simulated instrument transport delay is measured and the airplane delay should be subtracted from this total. This difference represents the introduced delay and should not exceed the standards prescribed in Table A1A. The inherent delay of the airplane between the data bus and the displays is indicated in figure A2GA. The display manufacturer should provide this delay time.

k. 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.

l. 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.

m. 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.

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Figure A2D
Transport Delay for simulation of classic non-computer controlled aircraft.

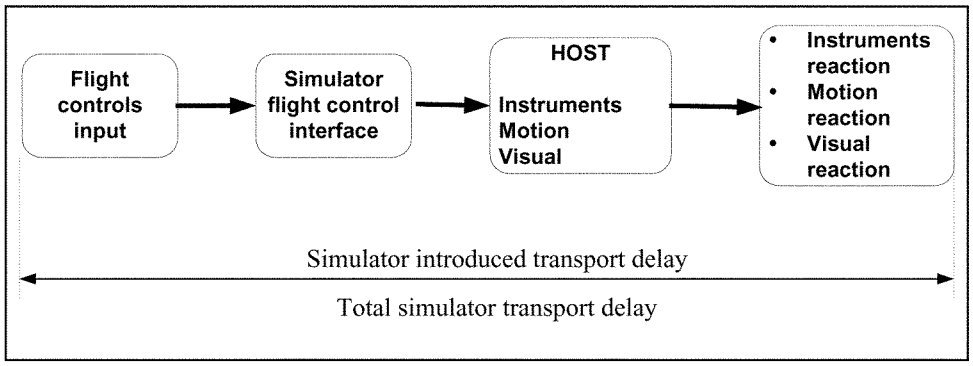


Figure A2E
Transport Delay for simulation of computer controlled aircraft using real airplane black boxes

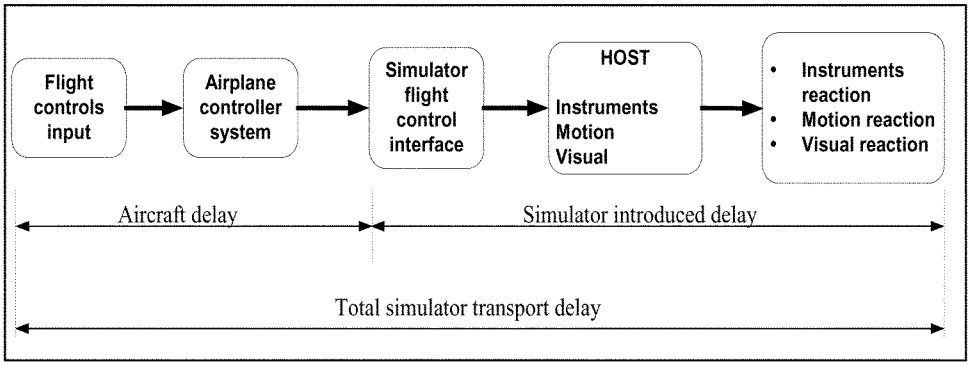


Figure A2F
Transport Delay for simulation of computer controlled aircraft using software emulation of airplane boxes

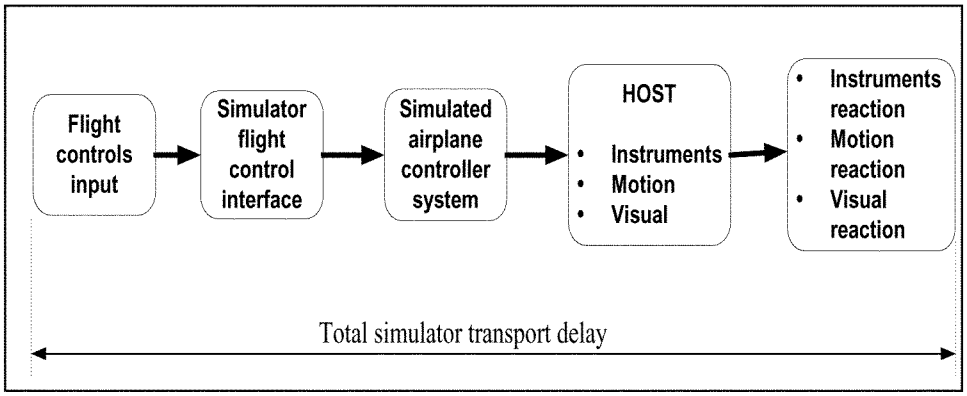
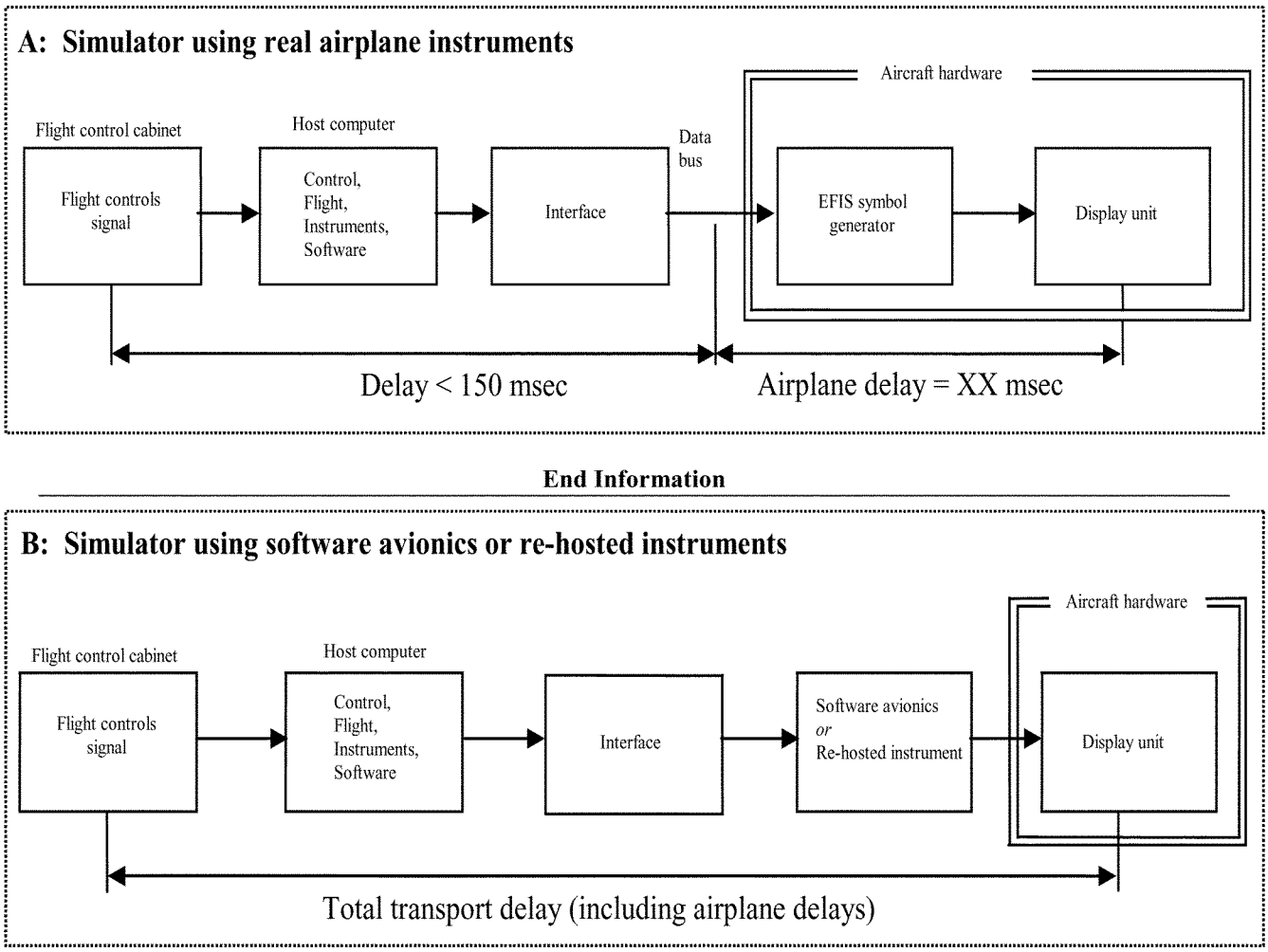


Figure A2GA and A2GB
Transport delay for simulation of airplanes using real or re-hosted instrument drivers



End Information

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Begin Information

16. Continuing Qualification Evaluations—Validation Test Data Presentation

a. Background

(1) The MQTG is created during the initial evaluation of a flight simulator. This is the master document, as amended, to which flight simulator continuing qualification evaluation test results are compared.

(2) The currently accepted method of presenting continuing qualification evaluation test results is to provide flight simulator results over-plotted with reference data. Test results are carefully reviewed to determine if the test is within the specified tolerances. This can be a time consuming process, particularly when reference data exhibits rapid variations or an apparent anomaly requiring engineering judgment in the application of the tolerances. In these cases, the solution is to compare the results to the MQTG. The continuing qualification results are compared to the results in the MQTG for acceptance. The flight simulator operator and the NSPM should look for any change in the flight simulator performance since initial qualification.

b. Continuing Qualification Evaluation Test Results Presentation

(1) Flight simulator operators are encouraged to over-plot continuing qualification validation test results with MQTG flight simulator results recorded during the initial evaluation and as amended. Any change in a validation test will be readily apparent. In addition to plotting continuing qualification validation test and MQTG results, operators may elect to plot reference data as well.

(2) There are no suggested tolerances between flight simulator continuing qualification and MQTG validation test results. Investigation of any discrepancy between the MQTG and continuing qualification flight simulator performance is left to the discretion of the flight simulator operator and the NSPM.

(3) Differences between the two sets of results, other than variations attributable to repeatability issues that cannot be explained, should be investigated.

(4) The flight simulator should retain the ability to over-plot both automatic and manual validation test results with reference data.

End Information

Begin QPS Requirements

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

a. 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 A2E.

End QPS Requirements

Begin Information

b. 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.

c. Based on this history of successful comparisons, the NSPM has concluded that those who are experienced in the development of aerodynamic models may use modeling techniques to alter the method for acquiring flight test data for Level A or Level B simulators.

d. The information in Table A2E (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.

(1) Alternative data sources that may be used for part or all of a data requirement are the Airplane Maintenance Manual, the Airplane Flight Manual (AFM), Airplane Design Data, the Type Inspection Report (TIR), Certification Data or acceptable supplemental flight test data.

(2) The sponsor should coordinate with the NSPM prior to using alternative data sources in a flight test or data gathering effort.

e. The NSPM position regarding the use of these alternative data sources, procedures, and instrumentation is based on the following presumptions:

(1) 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, unaccelerated, trimmed flight data. All of the simulator time history tests that begin in level, unaccelerated, 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.)

(2) 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.

f. The sponsor is urged to contact the NSPM for clarification of any issue regarding airplanes with reversible control systems. Table A2E is not applicable to Computer Controlled Aircraft FFSs.

g. Utilization of these alternate data sources, procedures, and instrumentation (Table A2E) 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.

h. The term ''inertial measurement system'' is used in the following table to include the use of a functional global positioning system (GPS).

i. Synchronized video for the use of alternative data sources, procedures, and instrumentation should have:

(1) Sufficient resolution to allow magnification of the display to make appropriate measurement and comparisons; and

(2) 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 ½ 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.

End Information

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Table A2E

Alternative Data Sources, Procedures, and Instrumentation				
QPS REQUIREMENTS The standards in this table are required if the data gathering methods described in paragraph 9 of Appendix A are not used.				**INFORMATION**
Table of Objective Tests **Test Entry Number and Title**	**Sim Level**		**Alternative Data Sources, Procedures, and Instrumentation**	**Notes**
	A	**B**		
1.a.1. Performance. Taxi. Minimum Radius turn	X	X	TIR, AFM, or Design data may be used.	
1.a.2. Performance. Taxi Rate of Turn vs. Nosewheel Steering Angle		X	Data may be acquired by using a constant tiller position, measured with a 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 NSPM concurrence.
1.b.1. Performance. Takeoff. Ground Acceleration Time and Distance	X	X	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. Performance. Takeoff. Minimum Control Speed - ground (V_{mcg}) using aerodynamic controls only (per applicable airworthiness standard) or low speed, engine inoperative ground control characteristics	X	X	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 sideforce generation.
1.b.3. Performance. Takeoff. Minimum Unstick Speed (V_{mu}) or equivalent test to demonstrate early rotation takeoff characteristics.	X	X	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and the force/position measurements of flight deck controls.	
1.b.4. Performance. Takeoff. Normal Takeoff	X	X	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.	X	X	Data may be acquired by using an	Record airplane dynamic

Table A2E

Alternative Data Sources, Procedures, and Instrumentation				
QPS REQUIREMENTS The standards in this table are required if the data gathering methods described in paragraph 9 of Appendix A are not used.				**INFORMATION**
Table of Objective Tests **Test Entry Number and Title**	**Sim Level**		**Alternative Data Sources, Procedures, and Instrumentation**	**Notes**
	A	**B**		
Performance. Takeoff. Critical Engine Failure during Takeoff			inertial measurement system and a synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls.	response to engine failure and control inputs required to correct flight path.
1.b. 6. Performance. Takeoff. Crosswind Takeoff	**X**	**X**	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.	The "1:7 law" to 100 feet (30 meters) is an acceptable wind profile.
1.b. 7. Performance. Takeoff. Rejected Takeoff	**X**	**X**	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.	
1.c. 1. Performance. Climb. Normal Climb all engines operating.	**X**	**X**	Data may be acquired with a synchronized video of calibrated airplane instruments and engine power throughout the climb range.	
1.c.2. Performance. Climb. One engine Inoperative Climb	**X**	**X**	Data may be acquired with a synchronized video of calibrated airplane instruments and engine power throughout the climb range.	
1.c.4. Performance. Climb. One Engine Inoperative Approach Climb (if operations in icing conditions are authorized)	**X**	**X**	Data may be acquired with a synchronized video of calibrated airplane instruments and engine power throughout the climb range.	
1.d.1. Cruise / Descent. Level flight acceleration.	**X**	**X**	Data may be acquired with a synchronized video of calibrated airplane instruments, thrust lever position, engine parameters, and elapsed time.	
1.d.2. Cruise / Descent. Level flight deceleration.	**X**	**X**	Data may be acquired with a synchronized video of calibrated airplane instruments, thrust lever position, engine parameters, and elapsed time.	
1.d.4. Cruise / Descent. Idle descent.	**X**	**X**	Data may be acquired with a synchronized video of calibrated airplane instruments, thrust lever position, engine parameters, and elapsed time.	
1.d.5.	**X**	**X**	Data may be acquired with a	

Table A2E

Alternative Data Sources, Procedures, and Instrumentation				
QPS REQUIREMENTS The standards in this table are required if the data gathering methods described in paragraph 9 of Appendix A are not used.				**INFORMATION**
Table of Objective Tests **Test Entry Number and Title**	**Sim Level**		**Alternative Data Sources, Procedures, and Instrumentation**	**Notes**
	A	**B**		
Cruise / Descent. Emergency Descent.			synchronized video of calibrated airplane instruments, thrust lever position, engine parameters, and elapsed time.	
1.e.1. Performance. Stopping. Deceleration time and distance, using manual application of wheel brakes and no reverse thrust on a dry runway.	**X**	**X**	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. Performance. Ground. Deceleration Time and Distance, using reverse thrust and no wheel brakes.	**X**	**X**	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 pertinent parameters of engine power.	
1.f.1. Performance. Engines. Acceleration	**X**	**X**	Data may be acquired with a synchronized video recording of engine instruments and throttle position.	
1.f.2. Performance. Engines. Deceleration	**X**	**X**	Data may be acquired with a synchronized video recording of engine instruments and throttle position.	
2.a.1.a. Handling Qualities. Static Control Checks. Pitch Controller Position vs. Force and Surface Position Calibration	**X**	**X**	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 NSPM, 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. Handling Qualities. Static Control Checks. Roll Controller Position vs. Force and Surface Position Calibration	**X**	**X**	Surface position data may be acquired from flight data recorder (FDR) sensor or, if no FDR sensor, at selected, significant wheel positions (encompassing significant wheel position data points), acceptable to the NSPM, using a control surface protractor on the ground. Force data may be acquired by using a hand held force gauge at the same wheel position data points.	For airplanes with reversible control systems, surface position data acquisition should be accomplished with winds less than 5 kts.
2.a.3.a.	**X**	**X**	Surface position data may be acquired	For airplanes with

Table A2E

Alternative Data Sources, Procedures, and Instrumentation				
QPS REQUIREMENTS The standards in this table are required if the data gathering methods described in paragraph 9 of Appendix A are not used.				**INFORMATION**
Table of Objective Tests **Test Entry Number and Title**	**Sim Level**		**Alternative Data Sources, Procedures, and Instrumentation**	**Notes**
	A	**B**		
Handling Qualities. Static Control Checks. Rudder Pedal Position vs. Force and Surface Position Calibration			from flight data recorder (FDR) sensor or, if no FDR sensor, at selected, significant rudder pedal positions (encompassing significant rudder pedal position data points), acceptable to the NSPM, using a control surface protractor on the ground. Force data may be acquired by using a hand held force gauge at the same rudder pedal position data points.	reversible control systems, surface position data acquisition should be accomplished with winds less than 5 kts.
2.a.4. Handling Qualities. Static Control Checks. Nosewheel Steering Controller Force and Position	**X**	**X**	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. Handling Qualities. Static Control Checks. Rudder Pedal Steering Calibration	**X**	**X**	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. Handling Qualities. Static Control Checks. Pitch Trim Indicator vs. Surface Position Calibration.	**X**	**X**	Data may be acquired through calculations.	
2.a.7. Handling qualities. Static control tests. Pitch trim rate.	**X**	**X**	Data may be acquired by using a synchronized video of pitch trim indication and elapsed time through range of trim indication.	
2.a.8. Handling Qualities. Static Control tests. Alignment of Flight deck Throttle Lever Angle vs. Selected engine parameter .	**X**	**X**	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. Handling qualities. Static control tests. Brake pedal position vs. force and brake system pressure calibration.	**X**	**X**	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.	
2.c.1.	**X**	**X**	Data may be acquired by using an	

Table A2E

Alternative Data Sources, Procedures, and Instrumentation				
QPS REQUIREMENTS The standards in this table are required if the data gathering methods described in paragraph 9 of Appendix A are not used.				**INFORMATION**
Table of Objective Tests **Test Entry Number and Title**	**Sim Level**		**Alternative Data Sources, Procedures, and Instrumentation**	**Notes**
	A	**B**		
Handling qualities. Longitudinal control tests. Power change dynamics			inertial measurement system and a synchronized video of calibrated airplane instruments and throttle position.	
2.c.2. Handling qualities. Longitudinal control tests. Flap/slat change dynamics	**X**	**X**	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. Handling qualities. Longitudinal control tests. Spoiler/speedbrake change dynamics	**X**	**X**	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and spoiler/speedbrake position.	
2.c.4. Handling qualities. Longitudinal control tests. Gear change dynamics	**X**	**X**	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and gear position.	
2.c.5. Handling qualities. Longitudinal control tests. Longitudinal trim	**X**	**X**	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. Handling qualities. Longitudinal control tests. Longitudinal maneuvering stability (stick force/g)	**X**	**X**	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. Handling qualities. Longitudinal control tests. Longitudinal static stability	**X**	**X**	Data may be acquired through the use of a synchronized video of airplane flight instruments and a hand held force gauge.	
2.c.8. Handling qualities. Longitudinal control tests. Stall characteristics	**X**	**X**	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. Handling qualities. Longitudinal control tests. Phugoid dynamics	**X**	**X**	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 A2E

Alternative Data Sources, Procedures, and Instrumentation				
QPS REQUIREMENTS The standards in this table are required if the data gathering methods described in paragraph 9 of Appendix A are not used.				**INFORMATION**
Table of Objective Tests **Test Entry Number and Title**	**Sim Level**		**Alternative Data Sources, Procedures, and Instrumentation**	**Notes**
	A	**B**		
2.c.10. Handling qualities. Longitudinal control tests. Short period dynamics		**X**	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.1. Handling qualities. Lateral directional tests. Minimum control speed, air (V_{mca} or V_{mci}), per applicable airworthiness standard or Low speed engine inoperative handling characteristics in the air	**X**	**X**	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.2. Handling qualities. Lateral directional tests. Roll response (rate).	**X**	**X**	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. Handling qualities. Lateral directional tests. Roll response to flight deck roll controller step input	**X**	**X**	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. Handling qualities. Lateral directional tests. Spiral stability	**X**	**X**	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. Handling qualities. Lateral directional tests. Engine inoperative trim	**X**	**X**	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	Trimming during second segment climb is not a certification task and should not be conducted until a safe altitude is reached.

Table A2E

Alternative Data Sources, Procedures, and Instrumentation				
QPS REQUIREMENTS The standards in this table are required if the data gathering methods described in paragraph 9 of Appendix A are not used.				**INFORMATION**
Table of Objective Tests **Test Entry Number and Title**	**Sim Level**		**Alternative Data Sources, Procedures, and Instrumentation**	**Notes**
	A	**B**		
			flight deck controls.	
2.d.6. Handling qualities. Lateral directional tests. Rudder response.	**X**	**X**	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments andforce/position measurements of rudder pedals.	
2.d.7. Handling qualities. Lateral directional tests. Dutch roll, (yaw damper OFF)	**X**	**X**	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. Handling qualities. Lateral directional tests. Steady state sideslip	**X**	**X**	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 angle.	
2.e.1. Handling qualities. Landings. Normal landing.		**X**	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. Handling qualities. Landings. Crosswind landing.		**X**	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.4. Handling qualities. Landings. One engine inoperative landing.		**X**	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane instruments and the force/position measurements of flight deck controls. Normal and lateral accelerations may be recorded in lieu of AOA and sideslip.	
2.e.5. Handling qualities. Landings. Autopilot landing (if applicable)		**X**	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. Normal and lateral accelerations may be recorded in lieu of AOA and sideslip.	
2.e.6. Handling qualities.		**X**	Data may be acquired by using an inertial measurement system and a	

Table A2E

Alternative Data Sources, Procedures, and Instrumentation				
QPS REQUIREMENTS The standards in this table are required if the data gathering methods described in paragraph 9 of Appendix A are not used.				**INFORMATION**
Table of Objective Tests **Test Entry Number and Title**	**Sim Level**		**Alternative Data Sources, Procedures, and Instrumentation**	**Notes**
	A	**B**		
Landings. All engines operating, autopilot, go around.			synchronized video of calibrated airplane instruments and force/position measurements of flight deck controls. Normal and lateral accelerations may be recorded in lieu of AOA and sideslip.	
2.e.7. Handling qualities. Landings. One engine inoperative go around.		**X**	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. Normal and lateral accelerations may be recorded in lieu of AOA and sideslip.	
2.e.8. Handling qualities. Landings. Directional control (rudder effectiveness with symmetric thrust).		**X**	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. Normal and lateral accelerations may be recorded in lieu of AOA and sideslip.	
2.e.9. Handling qualities. Landings. Directional control (rudder effectiveness with asymmetric reverse thrust).		**X**	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. Normal and lateral accelerations may be recorded in lieu of AOA and sideslip.	
2.f. Handling qualities. Ground effect. Test to demonstrate ground effect		**X**	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.	

End Information

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Begin Information

18. Visual Display Systems—Additional Information on Image Geometry Testing

a. Background.

(1) The geometry of the final image as displayed to each pilot should meet the criteria defined. This assumes that the individual optical components have been tested to demonstrate a performance that is adequate to achieve this end result.

b. Image Position. See test 4.a.2.a.1.

(1) When measured from the pilot's and co-pilot's eyepoint the centre of the image should be positioned horizontally between 0 degrees and 2 degrees inboard and within ± 0.25 degree vertically relative to the aircraft centreline taking into account any designed vertical offset.

(2) The differential between the measurements of horizontal position between each eyepoint should not exceed 1 degree.

(3) The tolerances are based on eye spacings of up to ±53.3 cm (±21 inches). Greater eye spacings should be accompanied by an explanation of any additional tolerance required.

c. Image Absolute Geometry. See test 4.a.2.a.2.

(1) The absolute geometry of any point on the image should not exceed 3 degrees from the theoretical position. This tolerance applies to the central 200 degrees by 40 degrees. For larger fields of view, there should be no distracting discontinuities outside this area.

d. Image Relative Geometry. See test 4.a.2.a.3.

(1) The relative geometry check is intended to test the displayed image to demonstrate that there are no significant changes in image size over a small angle of view. With high detail visual systems, the eye can be a very

powerful comparator to discern changes in geometric size. If there are large changes in image magnification over a small area of the picture the image can appear to 'swim' as it moves across the mirror.

(2) The typical Mylar-based mirror system will naturally tend to form a 'bathtub' shape. This can cause magnification or 'rush' effects at the bottom and top of the image. These can be particularly distracting in the lower half of the mirror when in the final approach phase and hence should be minimized. The tolerances are designed to try to keep these effects to an acceptable level while accepting the technology is limited in its ability to produce a perfect spherical shape.

(3) The 200° × 40° Field of View is divided up into 3 zones to set tolerances for relative geometry as shown in Figure B–9. The testing of the relative geometry should be conducted as follows:

(a) From the pilot's eye position, measure every visible 5 degree point on the vertical lines and horizontal lines. Also, at −90, −60, −30, 0 and +15 degrees in azimuth, measure all visible 1 degree points from the –10° point to the lowest visible point. *Note.— Not all points depicted on the pattern are measured, but they may be measured if observation suggests a problem.*

(b) From the co-pilot's eye position, measure every visible 5 degree point on the vertical lines and horizontal lines. Also, at +90, +60, +30, 0 and −15 degrees in azimuth, measure all visible 1 degree points from the –10° point to the lowest visible point. *Note.— Not all points depicted on the pattern are measured, but they may be measured if observation suggests a problem.*

(c) The relative spacing of points should not exceed the following tolerances when comparing the gap between one pair of dots with the gap between an adjacent pair:

Zone 1 < 0.075 degree/degree.
Zone 2 < 0.15 degree/degree.
Zone 3 < 0.2 degree/degree.

(d) Where 5 degree gaps are being measured the tolerances should be multiplied by 5, e.g., one 5 degree gap should not be more than (5*0.075) = 0.375 deg. more or less than the adjacent gap when in zone 1.

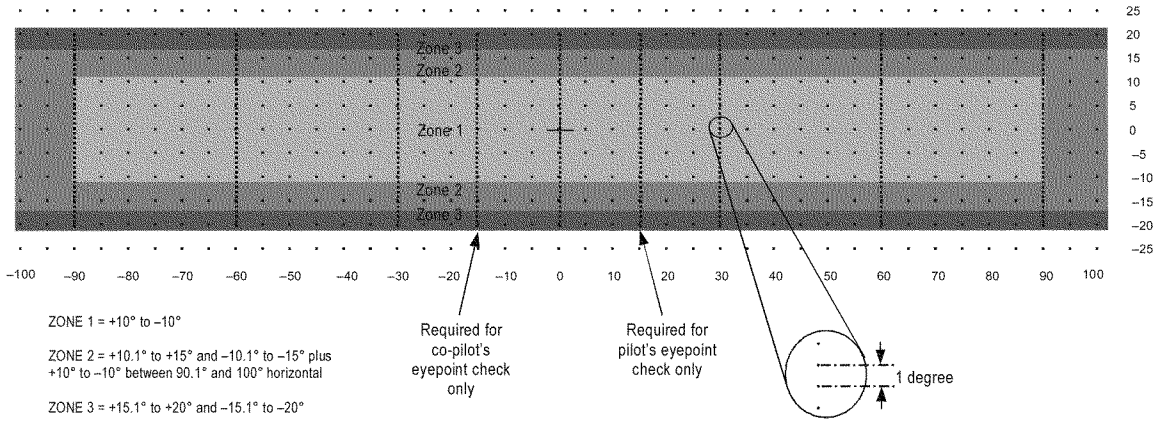
(e) For larger fields of view, there should be no distracting discontinuities outside this area.

(4) 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.

Figure A2H

Relative Geometry Test Pattern Showing Zones.

End Information



Attachment 3 to Appendix A to Part 60—Simulator Subjective Evaluation

Begin QPS Requirements

1. Requirements.

a. Except for special use airport models, described as Class III, all airport models required by this part 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 this attachment, as appropriate.

b. 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 SOC 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.''

c. 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. Detailed descriptions/definitions of these classifications are found in Appendix F of this part.

d. When a person sponsors an FFS maintained by a person other than a U.S. certificate holder, the sponsor is accountable for that FFS originally meeting, and continuing to meet, the criteria under which it was originally qualified and the appropriate Part 60 criteria, including the airport models that may be used by instructors or evaluators for purposes of training, checking, or testing under this chapter.

e. Neither Class II nor Class III airport visual models are required to appear on the SOQ, and the method used for keeping instructors and evaluators apprised of the airport models that meet Class II or Class III requirements on any given simulator is at the option of the sponsor, but the method used must be available for review by the TPAA.

f. 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 NSPM (described in paragraph 1.g. of this section), an update to that airport model must be made in accordance with the following time limits:

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

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

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

g. 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 NSPM stating the reason for the update delay and a proposed completion date, or explain why the update is not necessary (i.e., why the identified airport change will not have an impact on flight training, testing, or checking). A copy of this request or objection must also be sent to the POI/TCPM. The NSPM will send the official response to the sponsor and a copy to the POI/TCPM. If there is an objection, after consultation with the appropriate POI/TCPM regarding the training, testing, or checking impact, the NSPM will send the official response to the sponsor and a copy to the POI/TCPM.

End QPS Requirements

Begin Information

2. Discussion

a. 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.

b. The tests in Table A3A, Operations Tasks, in this attachment, address pilot functions, including maneuvers and procedures (called flight tasks), and are divided by flight phases. The performance of these tasks by the NSPM includes an operational examination of the visual system and special effects. There are flight tasks included to address some features of advanced technology airplanes and innovative training programs. For example, ''high angle-of-attack maneuvering'' is included to provide a required alternative to ''approach to stalls'' for airplanes employing flight envelope protection functions.

c. The tests in Table A3A, Operations Tasks, and Table A3G, Instructor Operating Station of this attachment, address the overall function and control of the simulator including the various simulated environmental conditions; simulated airplane system operations (normal, abnormal, and emergency); visual system displays; and special effects necessary to meet flight crew training, evaluation, or flight experience requirements.

d. All simulated airplane 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 airplane 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 NSP pilot will include in his report to the TPAA, the effect of the system operation and any system limitation.

e. Simulators demonstrating a satisfactory circling approach will be qualified for the circling approach maneuver and may be approved for such use by the TPAA in the sponsor's FAA-approved flight training program. To be considered satisfactory, the circling approach will be flown at maximum gross weight for landing, with minimum visibility for the airplane 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 (reference—14 CFR 91.175(e)).

f. At the request of the TPAA, the NSPM 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 NSPM determines that the simulator does not accurately simulate that training activity, the simulator would not be approved for that training activity.

g. The FAA 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 abilities (SKAs) necessary for competent performance of the tasks in which this particular media element is used. The analysis should describe the ability of the FFS/visual media to provide an adequate environment in which the required SKAs are satisfactorily performed and learned. The analysis should also include the specific media element, such as the airport model. Additional sources of information on the conduct of task and capability analysis may be found on the FAA's Advanced Qualification Program (AQP) Web site at: *http://www.faa.gov/education_research/training/aqp/.*

h. The TPAA may accept Class III airport models 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 SMGCS operations.

(b) Instrument operations training (including instrument takeoff, departure, arrival, approach, and missed approach training, testing, or checking) using—

(i) A specific model that has been geographically ''moved'' to a different location and aligned with an instrument procedure for another airport.

(ii) A model that does not match changes made at the real-world airport (or landing area for helicopters) being modeled.

(iii) 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.

i. 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:

(1) Early CGI visual systems that are excepted from the requirement of including runway numbers as a part of the specific runway marking requirements are:

(a) Link NVS and DNVS.

(b) Novoview 2500 and 6000.

(c) FlightSafety VITAL series up to, and including, VITAL III, but not beyond.

(d) Redifusion SP1, SP1T, and SP2.

(2) Early CGI visual systems are excepted from the requirement of including runway numbers unless the runways are used for 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:

(a) FlightSafety VITAL IV.

(b) Redifusion SP3 and SP3T.

(c) Link-Miles Image II.

(3) 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:

(a) Redifusion SP1.

(b) FlightSafety Vital IV.

(c) Link-Miles Image II and Image IIT

(d) XKD displays (even though the XKD image generator is capable of generating blue colored lights, the display cannot accommodate that color).

End Information

Table A3A

Functions And Subjective Tests					
QPS REQUIREMENTS					
Entry Number	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 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	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
2.d	**Other**				
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.	Crosswind (maximum demonstrated and gusting crosswind).	X	X	X	X
3.a.4.	Special performance				
3.a.4.a	Reduced V_1	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

Table A3A

Functions And Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Operations Tasks	Simulator Level			
		A	B	C	D
3.a.8.	Other				
3.b.	Abnormal/emergency.				
3.b.1.	Rejected Take-off.	X	X	X	X
3.b.2.	Rejected special performance (e.g., reduced V_1, 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). (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
3.b.6.	Other				
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
4.d.	Other				
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 V_{mo} or M_{mo}).	X	X	X	X
5.a.6.	High IAS handling.	X	X	X	X
5.a.7.	Other				
5.b.	**Maneuvers.**				
5.b.1.	High Angle of Attack				
5.b.1.a	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.1.b	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.2.	Slow flight	X	X	X	X
5.b.3.	Reserved			X	X
5.b.4.	Flight envelope protection (high angle of attack, bank limit,	X	X	X	X

Table A3A

Functions And Subjective Tests QPS REQUIREMENTS					
Entry Number	Operations Tasks	Simulator Level			
		A	B	C	D
	overspeed, etc.).				
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	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.			X	X
5.b.14.e	S-turns about a road or section line.			X	X
5.b.15	Upset recognition and recovery			X	X
5.b.16	Other.				
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
6.e.	Other				
7.	**Instrument Approaches And Landing.** 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
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

Table A3A

Functions And Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Operations Tasks	Simulator Level			
		A	B	C	D
7.a.1.e	HUD/EFVS.	X	X	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	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	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	With maximum tail wind component certified or authorized.	X	X	X	X
7.a.4.c	With maximum crosswind component demonstrated or authorized.	X	X	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

Table A3A

Functions And Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Operations Tasks	Simulator Level			
		A	B	C	D
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.** 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.	Approach and landing with crosswind (max. demonstrated and gusting crosswind).	X	X	X	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	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
8.k.	Other				
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
9.d.	With flight control system failures, reconfiguration modes, manual reversion and associated handling.	X	X	X	X
9.e.	Bounced landing			X	X
10.	**Surface Operations (landing, after-landing and post-flight).**				
10.a	**Landing roll and taxi.**				

Table A3A

Functions And Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Operations Tasks	Simulator Level			
		A	B	C	D
10.a.1	HUD/EFVS.				
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	Brake and anti-skid operation with dry and wet conditions.				
10.a.6.c	Brake and anti-skid operation with dry conditions.	X	X		
10.a.6.d	Auto-braking system operation.	X	X	X	X
10.a.7	Other				
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
10.b.3	Other.				
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				
11.a.10.	Pneumatic				
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
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

Table A3A

Functions And Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Operations Tasks	Simulator Level			
		A	B	C	D
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	X	X
11.a.26.	Automatic checklists (normal, abnormal and emergency procedures).	X	X	X	X
11.a.27.	Runway alerting and advisory system.	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
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

Functions and Subjective Tests					
QPS REQUIREMENTS					
Entry Number	For Qualification At The Stated Level Class I Airport 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.					
Begin QPS Requirements					
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 attachment 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:	X	X		
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.a.	**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. Not all of the elements described in this section must be found in a single airport model. 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 attachment are not designated as "in use," then the "in use"	X	X	X	X

Table A3B

Functions and Subjective Tests					
QPS REQUIREMENTS					
Entry Number	For Qualification At The Stated Level Class I Airport Models	Simulator Level			
		A	B	C	D
	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.				
2.a.2	**Visual scene fidelity.**				
2.a.2.a	The visual scene should 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				
2.a.3	**Runways and taxiways.**				
2.a.3.a	The airport 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 should be capable of being lit simultaneously.			**X**	**X**
2.a.5	Runway threshold elevations and locations should be modelled to provide correlation with airplane systems (e.g. HUD, GPS, compass, altimeter).			**X**	**X**
2.a.6	Slopes in runways, taxiways, and ramp areas should 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 should 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**

Table A3B

Functions and Subjective Tests					
QPS REQUIREMENTS					
Entry Number	**For Qualification At The Stated Level** **Class I Airport Models**	**Simulator Level**			
		A	**B**	**C**	**D**
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) 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**
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 should 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 should be correlated with the displayed runway surface and lighting.				**X**
2.a.12	**Airport buildings, structures and lighting.**				
2.a.12.a	Buildings, structures and lighting:				
2.a.12.a.	The airport buildings, structures and lighting.			**X**	**X**
2.a.12.a.	Reserved				
2.a.12.a.	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 gate clutter (e.g. other airplanes,			**X**	**X**

Table A3B

Functions and Subjective Tests					
QPS REQUIREMENTS					
Entry Number	**For Qualification At The Stated Level** **Class I Airport Models**	**Simulator Level**			
		A	**B**	**C**	**D**
	power carts, tugs, fuel trucks, additional gates).				
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.**				
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 should 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 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**		
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 should 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	**Visual approach aids lights.**				
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**		

Table A3B

Functions and Subjective Tests QPS REQUIREMENTS					
Entry Number	For Qualification At The Stated Level Class I Airport Models	Simulator Level			
		A	B	C	D
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 should 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
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 should 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 should be provided.			X	X
2.f	**Scene quality.**				
2.f.1	**Quantization.**				
2.f.1.a	Surfaces and textural cues should be free from apparent quantization (aliasing).			X	X
2.f.1.b	Surfaces and textural cues should not create distracting quantization (aliasing).	X	X		

Table A3B

Functions and Subjective Tests QPS REQUIREMENTS					
Entry Number	For Qualification At The Stated Level Class I Airport Models	Simulator Level			
		A	B	C	D
2.f.2	System capable of portraying full color realistic textural cues.			X	X
2.f.3	The system light points should be free from distracting jitter, smearing or streaking.	X	X	X	X
2.f.4	System capable of providing focus effects that simulate rain.			X	X
2.f.5	System capable of providing light point perspective growth.			X	X
2.g	**Environmental effects.**				
2.g.1	The displayed scene should correspond to the appropriate surface contaminants and include runway lighting reflections for wet, partially obscured lights for snow, or suitable alternative effects.			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, if appropriate to the operator's area of operations, 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 600 m (2 000 ft) above the airport and within a radius of 16 km (10 sm) from the airport. Transition effects should be complete when the IOS cloud base or top is reached when exiting and start when entering the cloud, i.e. transition effects should occur within the IOS defined cloud layer.			X	X
2.g.7	Visibility and RVR measured in terms of distance. Visibility/RVR should be checked at and below a height of 600 m (2 000 ft) above the airport and within a radius of 16 km (10 sm) from the airport.	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, ie. variability is only > IOS RVR.			X	X
2.g.9	Effects of fog on airport lighting such as halos and defocus.			X	X
2.g.10	Effect of ownship 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 A3B

Functions and Subjective Tests					
QPS REQUIREMENTS					
Entry Number	**For Qualification At The Stated Level** **Class I Airport Models**	**Simulator Level**			
		A	**B**	**C**	**D**
	End QPS Requirement				
	Begin Information				
3.	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, does not cause changes in navigational radio frequencies, and does not cause undue instructor/evaluator time.				
4.	Sponsors are not required to provide every detail of a runway, but the detail that is provided should be correct within the capabilities of the system. **End Information**				

Table A3C

Functions and Subjective Tests					
QPS REQUIREMENTS					
Entry Number	**Additional Airport Models Beyond Minimum Required for Qualification Class II Airport 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 NSPM or TPAA.					
	Begin QPS Requirements				
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**

Table A3C

Functions and Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Additional Airport Models Beyond Minimum Required for Qualification Class II Airport Models	Simulator Level			
		A	B	C	D
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
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

Table A3C

Functions and Subjective Tests					
QPS REQUIREMENTS					
Entry Number	**Additional Airport Models Beyond Minimum Required for Qualification Class II Airport Models**	**Simulator Level**			
		A	**B**	**C**	**D**
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**
End QPS Requirements					
Begin Information					
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**
End Information					

Table A3D

Functions and Subjective Tests						
QPS REQUIREMENTS						INFORMATION
Entry Number	Motion System Effects	Simulator Level				Notes
		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 and directional cues resulting from steering and braking inputs.**			X	X	
2.	**Runway rumble, oleo deflection, ground speed, uneven runway, runway/taxiway centerline light characteristics, runway contamination with associated anti-skid and taxiway 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	
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	
5.	**Buffet during extension and retraction of landing gear:** Procedure: Operate the landing gear. Check that the motion cues of		X	X	X	

Table A3D

Functions and Subjective Tests						
QPS REQUIREMENTS						INFORMATION
Entry Number	Motion System Effects	Simulator Level				Notes
		A	B	C	D	
	the buffet experienced represent the actual airplane.					
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	
7.	**Buffet due to atmospheric disturbances.**			X	X	
8.	**Approach to stall buffet:** Procedure: Conduct an approach-to-stall with engines at idle and a deceleration of 1 knot/second. Check that the motion cues of the buffet, including the level of buffet increase with decreasing speed, are representative of the actual airplane.		X	X	X	
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	
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.		X	X	X	This effect is most discernible with wing-mounted engines.

Table A3D

Functions and Subjective Tests						
QPS REQUIREMENTS						INFORMATION
Entry Number	Motion System Effects	Simulator Level				Notes
		A	B	C	D	
	Confirm that the buffet increases appropriately with increasing engine thrust.					
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.
14.	**Engine failures, malfunction, engine, and airframe structural damage:** Procedure: The characteristics of an engine malfunction as stipulated		X	X	X	

Table A3D

Functions and Subjective Tests						
QPS REQUIREMENTS						INFORMATION
Entry Number	Motion System Effects	Simulator Level				Notes
		A	B	C	D	
	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.					
15.	**Tail strikes, engine pod/propeller, wing strikes:** Procedure: Tail-strikes can be checked by over-rotation of the airplane at a speed below V_r 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.

Table A3E

Functions and Subjective Tests					
QPS REQUIREMENTS					
Entry Number	**Sound System**	**Simulator Level**			
		A	**B**	**C**	**D**
The following checks are performed during a normal flight profile with motion system ON.					
1.	Precipitation.			**X**	**X**
2.	Rain removal equipment.			**X**	**X**
3.	Significant airplane noises perceptible to the pilot during normal operations.			**X**	**X**
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.			**X**	**X**
5.	Sound of a crash when the flight simulator is landed in excess of limitations.			**X**	**X**

Table A3F

Functions and Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Special Effects	Simulator Level			
		A	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 airplane), including antiskid and decreased brake efficiency due to high brake temperatures (based on airplane 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 airplanes 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. Activate heating, anti-ice, or de-ice systems independently. Recognition will include proper effects of these systems, eventually returning the simulated airplane to normal flight.			X	X

Table A3G

Functions and Subjective Tests QPS REQUIREMENTS					
Entry Number	Instructor Operating Station (IOS) (As appropriate)	Simulator Level			
		A	B	C	D
	Functions in this table are subject to evaluation only if appropriate for the airplane and/or the system is installed on the specific simulator.				
1.	**Simulator Power Switch(es)**	**X**	**X**	**X**	**X**
2.	**Airplane conditions.**				
2.a.	Gross weight, center of gravity, fuel loading and allocation	**X**	**X**	**X**	**X**
2.b.	Airplane systems status.	**X**	**X**	**X**	**X**
2.c.	Ground crew functions (e.g., ext. power, push back)	**X**	**X**	**X**	**X**
3.	**Airports.**				
3.a.	Number and selection.	**X**	**X**	**X**	**X**
3.b.	Runway selection.	**X**	**X**	**X**	**X**
3.c.	Runway surface condition (e.g., rough, smooth, icy, wet)			**X**	**X**
3.d.	Preset positions (e.g., ramp, gate, #1 for takeoff, takeoff position, over FAF)	**X**	**X**	**X**	**X**
3.e.	Lighting controls.	**X**	**X**	**X**	**X**
4.	**Environmental controls.**				
4.a	Visibility (statute miles (kilometers)).	**X**	**X**	**X**	**X**
4.b.	Runway visual range (in feet (meters)).	**X**	**X**	**X**	**X**
4.c.	Temperature.	**X**	**X**	**X**	**X**
4.d.	Climate conditions (e.g., ice, snow, rain).	**X**	**X**	**X**	**X**
4.e.	Wind speed and direction.	**X**	**X**	**X**	**X**
4.f.	Windshear.			**X**	**X**
4.g.	Clouds (base and tops).	**X**	**X**	**X**	**X**
5.	**Airplane system malfunctions** (Inserting and deleting malfunctions into the simulator).	**X**	**X**	**X**	**X**
6.	**Locks, Freezes, and Repositioning.**				
6.a.	Problem (all) freeze / release.	**X**	**X**	**X**	**X**
6.b.	Position (geographic) freeze / release.	**X**	**X**	**X**	**X**
6.c.	Repositioning (locations, freezes, and releases).	**X**	**X**	**X**	**X**
6.d.	Ground speed control.	**X**	**X**	**X**	**X**
7.	Remote IOS.	**X**	**X**	**X**	**X**
8.	**Sound Controls.** On / off / adjustment	**X**	**X**	**X**	**X**
9.	**Motion / Control Loading System.**				
9.a.	**On / off / emergency stop.**	**X**	**X**	**X**	**X**
10.	**Observer Seats / Stations.** Position / Adjustment / Positive restraint system.	**X**	**X**	**X**	**X**

Begin Information

1. Introduction

a. 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. 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, sponsor, and training task.

b. 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:

(1) 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.

(2) The simulator should be capable of operating reliably after the use of training device functions such as repositions or malfunctions.

c. 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.

2. Events

a. Initial Conditions.
(1) Airport.
(2) QNH.
(3) Temperature.
(4) Wind/Crosswind.
(5) Zero Fuel Weight/Fuel/Gross Weight/Center of Gravity.
b. Initial Checks.
(1) Documentation of Simulator.
(a) Simulator Acceptance Test Manuals.
(b) Simulator Approval Test Guide.
(c) Technical Logbook Open Item List.
(d) Daily Functional Pre-flight Check.
(2) Documentation of User/Carrier Flight Logs.
(a) Simulator Operating/Instructor Manual.
(b) Difference List (Aircraft/Simulator).
(c) Flight Crew Operating Manuals.
(d) Performance Data for Different Fields.
(e) Crew Training Manual.
(f) Normal/Abnormal/Emergency Checklists.
(3) Simulator External Checks.
(a) Appearance and Cleanliness.
(b) Stairway/Access Bridge.
(c) Emergency Rope Ladders.
(d) ''Motion On''/''Flight in Progress'' Lights.
(4) Simulator Internal Checks.
(a) Cleaning/Disinfecting Towels (for cleaning oxygen masks).
(b) Flight deck Layout (compare with difference list).
(5) Equipment.
(a) Quick Donning Oxygen Masks.
(b) Head Sets.
(c) Smoke Goggles.
(d) Sun Visors.
(e) Escape Rope.
(f) Chart Holders.
(g) Flashlights.
(h) Fire Extinguisher (inspection date).
(i) Crash Axe.
(j) Gear Pins.
c. Power Supply and APU Start Checks.
(1) Batteries and Static Inverter.
(2) APU Start with Battery.
(3) APU Shutdown using Fire Handle.
(4) External Power Connection.
(5) APU Start with External Power.
(6) Abnormal APU Start/Operation.
d. Flight deck Checks.
(1) Flight deck Preparation Checks.
(2) FMC Programming.
(3) Communications and Navigational Aids Checks.
e. Engine Start.
(1) Before Start Checks.
(2) Battery start with Ground Air Supply Unit.
(3) Engine Crossbleed Start.
(4) Normal Engine Start.
(5) Abnormal Engine Starts.
(6) Engine Idle Readings.
(7) After Start Checks.
f. Taxi Checks.
(1) Pushback/Powerback.
(2) Taxi Checks.
(3) Ground Handling Check:
(a) Power required to initiate ground roll.
(b) Thrust response.
(c) Nosewheel and Pedal Steering.
(d) Nosewheel Scuffing.
(e) Perform 180 degree turns.
(f) Brakes Response and Differential Braking using Normal, Alternate and Emergency.
(g) Brake Systems.
(h) Eye height and fore/aft position.
(4) Runway Roughness.
g. Visual Scene—Ground Assessment. Select 3 different airport models and perform the following checks with Day, Dusk and Night selected, as appropriate:
(1) Visual Controls.
(a) Daylight, Dusk, Night Scene Controls.
(b) Flight deck ''Daylight'' ambient lighting.
(c) Environment Light Controls.
(d) Runway Light Controls.
(e) Taxiway Light Controls.
(2) Airport Model Content.
(a) Ramp area for buildings, gates, airbridges, maintenance ground Equipment, parked aircraft.
(b) Daylight shadows, night time light pools.
(c) Taxiways for correct markings, taxiway/runway, marker boards, CAT I and II/III hold points, taxiway shape/grass areas, taxiway light (positions and colors).
(d) Runways for correct markings, lead-off lights, boards, runway slope, runway light positions, and colors, directionality of runway lights.
(e) Airport environment for correct terrain and significant features.
(f) Visual scene quantization (aliasing), color, and occulting levels.
(3) Ground Traffic Selection.
(4) Environment Effects.
(a) Low cloud scene.
(i) Rain:
(A) Runway surface scene.
(B) Windshield wiper—operation and sound.
(ii) Hail:
(A) Runway surface scene.
(B) Windshield wiper—operation and sound.
(b) Lightning/thunder.
(c) Snow/ice runway surface scene.
(d) Fog.
h. Takeoff. Select one or several of the following test cases:
(1) T/O Configuration Warnings.
(2) Engine Takeoff Readings.
(3) Rejected Takeoff (Dry/Wet/Icy Runway) and check the following:
(a) Autobrake function.
(b) Anti-skid operation.
(c) Motion/visual effects during deceleration.
(d) Record stopping distance (use runway plot or runway lights remaining).
Continue taxiing along the runway while applying brakes and check the following:
(e) Center line lights alternating red/white for 2000 feet/600 meters.
(f) Center line lights all red for 1000 feet/300 m.
(g) Runway end, red stop bars.
(h) Braking fade effect.
(i) Brake temperature indications.
(4) Engine Failure between VI and V2
(5) Normal Takeoff:
(a) During ground roll check the following:
(i) Runway rumble.
(ii) Acceleration cues.
(iii) Groundspeed effects.
(iv) Engine sounds.
(v) Nosewheel and rudder pedal steering.
(b) During and after rotation, check the following:
(i) Rotation characteristics.
(ii) Column force during rotation.
(iii) Gear uplock sounds/bumps.
(iv) Effect of slat/flap retraction during climbout.
(6) Crosswind Takeoff (check the following):
(a) Tendency to turn into or out of the wind.
(b) Tendency to lift upwind wing as airspeed increase.
(7) Windshear during Takeoff (check the following):
(a) Controllable during windshear encounter.
(b) Performance adequate when using correct techniques.
(c) Windshear Indications satisfactory.
(d) Motion cues satisfactory (particularly turbulence).
(8) Normal Takeoff with Control Malfunction
(9) Low Visibility T/O (check the following):
(a) Visual cues.
(b) Flying by reference to instruments.
(c) SID Guidance on LNAV.
i. Climb Performance. Select one or several of the following test cases:
(1) Normal Climb—Climb while maintaining recommended speed profile and note fuel, distance and time.
(2) 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 en route climb speed and retract flaps. Climb for 3 minutes and note fuel, distance, and time.
j. Systems Operation During Climb.
Check normal operation and malfunctions as appropriate for the following systems:
(1) Air conditioning/Pressurization/Ventilation.
(2) Autoflight.
(3) Communications.
(4) Electrical.
(5) Fuel.
(6) Icing Systems.
(7) Indicating and Recording systems.
(8) Navigation/FMS.
(9) Pneumatics.
k. Cruise Checks. Select one or several of the following test cases:
(1) Cruise Performance.
(2) High Speed/High Altitude Handling (check the following):
(a) Overspeed warning.
(b) High Speed buffet.
(c) Aircraft control satisfactory.

(d) Envelope limiting functions on Computer Controlled Aircraft.

Reduce airspeed to below level flight buffet onset speed, start a turn, and check the following:

(e) High Speed buffet increases with G loading.

Reduce throttles to idle and start descent, deploy the speedbrake, and check the following:

(f) Speedbrake indications.

(g) Symmetrical deployment.

(h) Airframe buffet.

(i) Aircraft response hands off.

(3) Yaw Damper Operation. Switch off yaw dampers and autopilot. Initiate a Dutch roll and check the following:

(a) Aircraft dynamics.

(b) Simulator motion effects.

Switch on yaw dampers, re-initiate a Dutch roll and check the following:

(c) Damped aircraft dynamics.

(4) APU Operation.

(5) Engine Gravity Feed.

(6) Engine Shutdown and Driftdown Check: FMC operation Aircraft performance.

(7) Engine Relight.

l. Descent. Select one of the following test cases:

(1) Normal Descent Descend while maintaining recommended speed profile and note fuel, distance And time.

(2) Cabin Depressurization/Emergency Descent.

m. Medium Altitude Checks. Select one or several of the following test cases:

(1) High Angle of Attack/Stall. Trim the aircraft at 1.4 Vs, establish 1 kt/sec^2 deceleration rate, and check the following—

(a) System displays/operation satisfactory.

(b) Handling characteristics satisfactory.

(c) Stall and Stick shaker speed.

(d) Buffet characteristics and onset speed.

(e) Envelope limiting functions on Computer Controlled Aircraft.

Recover to straight and level flight and check the following:

(f) Handling characteristics satisfactory.

(2) Turning Flight. Roll aircraft to left, establish a 30° to 45° bank angle, and check the following:

(a) Stick force required, satisfactory.

(b) Wheel requirement to maintain bank angle.

(c) Slip ball response, satisfactory.

(d) Time to turn 180°.

Roll aircraft from 45° bank one way to 45° bank the opposite direction while maintaining altitude and airspeed—check the following:

(e) Controllability during maneuver.

(3) Degraded flight controls.

(4) Holding Procedure (check the following:)

(a) FMC operation.

(b) Autopilot auto thrust performance.

(5) Storm Selection (check the following:)

(a) Weather radar controls.

(b) Weather radar operation.

(c) Visual scene corresponds with WXR pattern.

(Fly through storm center, and check the following:)

(d) Aircraft enters cloud.

(e) Aircraft encounters representative turbulence.

(f) Rain/hail sound effects evident.

As aircraft leaves storm area, check the following:

(g) Storm effects disappear.

(6) TCAS (check the following:)

(a) Traffic appears on visual display.

(b) Traffic appears on TCAS display(s).

As conflicting traffic approaches, take relevant avoiding action, and check the following:

(c) Visual and TCAS system displays.

n. 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:

(1) Flaps/Gear Normal Operation. Check the following:

(a) Time for extension/retraction.

(b) Buffet characteristics.

(2) Normal Visual Approach and Landing.

Fly a normal visual approach and landing—check the following:

(a) Aircraft handling.

(b) Spoiler operation.

(c) Reverse thrust operation.

(d) Directional control on the ground.

(e) Touchdown cues for main and nosewheel.

(f) Visual cues.

(g) Motion cues.

(h) Sound cues.

(i) Brake and Anti-skid operation.

(3) Flaps/Gear Abnormal Operation or with hydraulic malfunctions.

(4) Abnormal Wing Flaps/Slats Landing.

(5) Manual Landing with Control Malfunction.

(a) Aircraft handling.

(b) Radio Aids and instruments.

(c) Airport model content and cues.

(d) Motion cues.

(e) Sound cues.

(6) Non-precision Approach—All Engines Operating.

(a) Aircraft handling.

(b) Radio Aids and instruments.

(c) Airport model content and cues.

(d) Motion cues.

(e) Sound cues.

(7) Circling Approach.

(a) Aircraft handling.

(c) Radio Aids and instruments.

(d) Airport model content and cues.

(e) Motion cues.

(f) Sound cues.

(8) Non-precision Approach—One Engine Inoperative.

(a) Aircraft handling.

(b) Radio Aids and instruments.

(c) Airport model content and cues.

(d) Motion cues.

(e) Sound cues.

(9) One Engine Inoperative Go-around.

(a) Aircraft handling.

(b) Radio Aids and instruments.

(c) Airport model content and cues.

(d) Motion cues.

(e) Sound cues.

(10) CAT I Approach and Landing with raw-data ILS.

(a) Aircraft handling.

(b) Radio Aids and instruments.

(c) Airport model content and cues.

(d) Motion cues.

(e) Sound cues.

(11) CAT I Approach and Landing with Limiting Crosswind.

(a) Aircraft handling.

(b) Radio Aids and instruments.

(c) Airport model content and cues.

(d) Motion cues.

(e) Sound cues.

(12) CAT I Approach with Windshear. Check the following:

(a) Controllable during windshear encounter.

(b) Performance adequate when using correct techniques.

(c) Windshear indications/warnings.

(d) Motion cues (particularly turbulence).

(13) CAT II Approach and Automatic Go-Around.

(14) CAT Ill Approach and Landing—System Malfunctions.

(15) CAT Ill Approach and Landing—1 Engine Inoperative.

(16) GPWS evaluation.

o. Visual Scene—In-Flight Assessment.

Select three (3) different visual models and perform the following checks with ''day,'' ''dusk,'' and ''night'' (as appropriate) selected. 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 Airport model content as described below:

(1) Visual Controls.

(a) Daylight, Dusk, Night Scene Controls.

(b) Environment Light Controls.

(c) Runway Light Controls.

(d) Taxiway Light Controls.

(e) Approach Light Controls.

(2) Airport model Content.

(a) Airport environment for correct terrain and significant features.

(b) Runways for correct markings, runway slope, directionality of runway lights.

(c) Visual scene for quantization (aliasing), color, and occulting.

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 the following:

(3) Airport model content.

(a) Airfield features.

(b) Approach lights.

(c) Runway definition.

(d) Runway definition.

(e) Runway edge lights and VASI lights.

(f) Strobe lights.

Release flight freeze. Continue flying the approach with NP engaged. Select flight freeze when aircraft is 3 sm/5 km out and on the glide slope. Check the following:

(4) Airport model Content.

(a) Runway centerline light.

(b) Taxiway definition and lights.

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 the following:

(5) Airport model content.

(a) Runway threshold lights.

(b) Touchdown zone lights.

At 200 ft radio altitude and still on glide slope, select Flight Freeze. Check the following:

(6) Airport model content.

(a) Runway markings.

Set the weather to Category I conditions and check the following:

(7) Airport model content.

(a) Visual ground segment.

Set the weather to Category II conditions, release Flight Freeze, re-select Flight.

Freeze at 100 feet radio altitude, and check the following:

(8) Airport model content.

(a) Visual ground segment.

Select night/dusk (twilight) conditions and check the following:

(9) Airport model content.

(a) Runway markings visible within landing light lobes.

Set the weather to Category III conditions, release Flight Freeze, re-select Flight Freeze at 50 feet radio altitude and check the following:

(10) Airport model content.

(a) Visual ground segment.

Set WX to a typical ''missed approach'' weather condition, release Flight Freeze, re-select Flight Freeze at 15 feet radio altitude, and check the following:

(11) Airport model content.

(a) Visual ground segment.

When on the ground, stop the aircraft. Set 0 feet RVR, ensure strobe/beacon tights are switched on and check the following:

(12) Airport model content.

(a) Visual effect of strobe and beacon.

Reposition to final approach, set weather to ''Clear,'' continue approach for an automatic landing, and check the following:

(13) Airport model content.

(a) Visual cues during flare to assess sink rate.

(b) Visual cues during flare to assess Depth perception.

(c) Flight deck height above ground.

p. After Landing Operations.

(1) After Landing Checks.

(2) Taxi back to gate. Check the following:

(a) Visual model satisfactory.

(b) Parking brake operation satisfactory.

(3) Shutdown Checks.

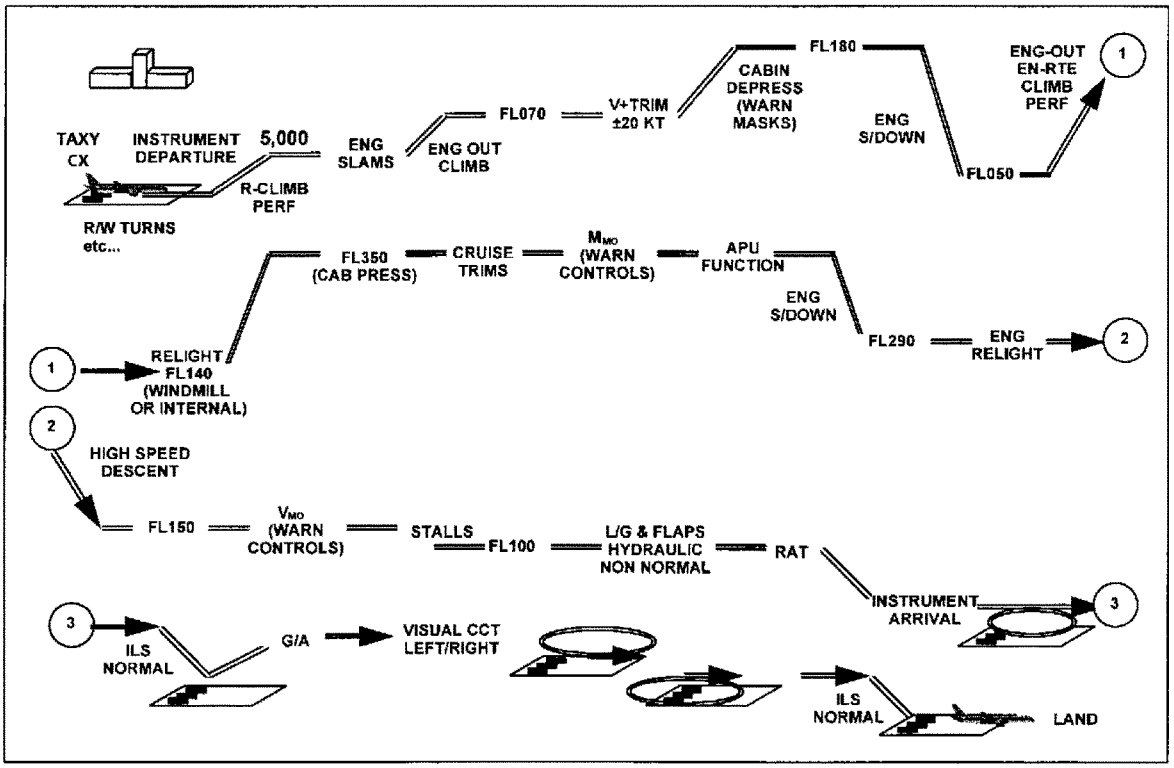
q. Crash Function.

(1) Gear-up Crash.

(2) Excessive rate of descent Crash.

(3) Excessive bank angle Crash.

Typical Subjective Continuing Qualification Evaluation Profile (2 hours)



Attachment 4 to Appendix A to Part 60—Sample Documents

Table of Contents

Title of Sample

Figure A4A—Sample Letter, Request for Initial, Upgrade, or Reinstatement Evaluation.

Figure A4B—Attachment: FFS Information Form

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Figure A4E—Sample Statement of Qualification—Certificate

Figure A4F—Sample Statement of Qualification—Configuration List

Figure A4G—Sample Statement of Qualification—List of Qualified Tasks

Figure A4H—Sample Continuing Qualification Evaluation Requirements Page

Figure A4I—Sample MQTG Index of Effective FFS Directives

Attachment 4 to Appendix A to Part 60—
Figure A4A – Sample Letter , Request for Initial, Upgrade, or Reinstatement Evaluation INFORMATION

Date _____

Edward D. Cook, Ph.D.
Manager, National Simulator Program
Federal Aviation Administration
100 Hartsfield Centre Parkway, Suite 400
Atlanta, GA 30354

Dear Dr. Cook:

RE: Request for Initial/Upgrade Evaluation Date

This is to advise you of our intent to request an (initial or upgrade) evaluation of our (FFS Manufacturer), (Aircraft Type/Level) Full Flight Simulator (FFS), (FAA ID Number, if previously qualified), located in (City, State) at the (Facility) on (Proposed Evaluation Date). (The proposed evaluation date shall not be more than 180 days following the date of this letter.) The FFS will be sponsored by (Name of Training Center/Air Carrier), FAA Designator (4 Letter Code). The FFS will be sponsored as follows: (Select One)

☐ The FFS will be used within the sponsor's FAA approved training program and placed on the sponsor's Training/Operations Specifications.

☐ The FFS will be used for dry lease only.

We agree to provide the formal request for the evaluation to your staff as follows: (check one)

☐ For QTG tests run at the factory, not later, than 45 days prior to the proposed evaluation date with the additional "l/3 on-site" tests provided not later than 14 days prior to the proposed evaluation date.

☐ For QTG tests run on-site, not later than 30 days prior to the proposed evaluation date.

We understand that the formal request will contain the following documents:

1. Sponsor's Letter of Request (*Company Compliance Letter*).
2. Principal Operations Inspector (POI) or Training Center Program Manager's (TCPM) endorsement.
3. Complete QTG.

If we are unable to meet the above requirements, we understand this may result in a significant delay, perhaps 45 days or more, in rescheduling and completing the evaluation.

(The sponsor should add additional comments as necessary).

Please contact (Name Telephone and Fax Number of Sponsor's Contact) to confirm the date for this initial evaluation. We understand a member of your National Simulator Program staff will respond to this request within 14 days.

A copy of this letter of intent has been provided to (Name), the Principal Operations Inspector (POI) and/or Training Center Program Manager (TCPM).

Sincerely,

Attachment: FFS Information Form
cc: POI/TCPM

Attachment 4 to Appendix A to Part 60—
Figure A4B – Sample Letter , Request for Initial, Upgrade, or Reinstatement Evaluation
Attachment: FSTD Information Form
INFORMATION

Date: _____			
Section 1. FSTD Information and Characteristics			
Sponsor Name:	_____	**FSTD Location**:	
Address:	_____ _____	**Physical Address:**	_____ _____
City:	_____	**City:**	_____
State:	_____	**State:**	_____
Country:	_____	**Country:**	_____
ZIP:	_____	**ZIP:**	_____
Manager	_____		
Sponsor ID No: (Four Letter FAA Designator)	_____	**Nearest Airport:** (Airport Designator)	_____
Type of Evaluation Requested:	☐ **Initial** ☐ **Upgrade** ☐ **Continuing Qualification** ☐ **Special** ☐ **Reinstatement**		
Aircraft Make/model/series:	_____		
Initial Qualification: (If Applicable)	**Date:** _____ **Level** _____ MM/DD/YYYY	**Manufacturer's Identification or Serial Number**	_____
Upgrade Qualification: (If Applicable)	**Date:** _____ **Level** _____ MM/DD/YYYY	☐ **eMQTG**	
Qualification Basis:_____	☐ **A** ☐ **B** ☐ **Interim C** ☐ **C** ☐ **D** ☐ **6** ☐ **7** ☐ **Provisional Status**		
Other Technical Information:			
FAA FSTD ID No: (If Applicable)	_____	**FSTD Manufacturer:**	_____
Convertible FSTD:	☐ **Yes**:	**Date of Manufacture**:	_____ MM/DD/YYYY
Related FAA ID No. (If Applicable)	_____ _____ _____	**Sponsor FSTD ID No:** _____	
Engine model(s) and data revision: _____		**Source of aerodynamic model:** _____	
FMS identification and revision level: _____		**Source of aerodynamic coefficient data:** _____	
Visual system manufacturer/model: _____		**Aerodynamic data revision number:** _____	
Flight control data revision: _____		**Visual system display:** _____	
Mot ion system manufacturer/type: _____		**FSTD computer(s) identification:** _____	
National Aviation Authority (NAA): (If Applicable)	_____		
NAA FSTD ID No:	_____	**Last NAA Evaluation Date:**	_____
NAA Qualification Level:	_____		
NAA Qualification Basis:	_____		
Visual System Manufacturer and Type:	_____	**FSTD Seats Available:** _____	**Motion System Manufacturer and Type:** _____:

Attachment 4 to Appendix A to Part 60—
Figure A4B – Sample Letter , Request for Initial, Upgrade, or Reinstatement Evaluation
Attachment: FSTD Information Form
INFORMATION

Aircraft Equipment:	**Engine Type(s):**	**Flight Instrumentation:**	**Engine Instrumentation:**
	_____ _____	☐ EFIS ☐ HUD ☐ HGS ☐ EFVS ☐ TCAS ☐ GPWS ☐ Plain View ☐ GPS ☐ FMS Type: ___ ☐ WX Radar ☐ Other: ___	☐ EICAS ☐ FADEC ☐ Other: ___

Airport Models:	3.6.1 _____ Airport Designator	3.6.2_____ Airport Designator	3.6.3 _____ Airport Designator
Circle to Land:	3. 7.1 _____ Airport Designator	3. 7.2_____ Approach	3. 7.3 _____ Landing Runway
Visual Ground Segment	3.8.1 _____ Airport Designator	3.8 .2_____ Approach	3. 8.3 _____ Landing Runway

Section 2. Supplementary Information			
FAA Training Program Approval Authority:		☐ **POI** ☐ **TCPM** ☐ **Other:** _____	
Name:	_____	**Office:**	_____
Tel:	_____	**Fax:**	_____
Email:	_____		
FSTD Scheduling Person:			
Name:	_____		
Address 1:	_____	**Address 2**	_____
City:	_____	**State:**	_____
ZIP:	_____	**Email:**	_____
Tel:	_____	**Fax:**	_____
FSTD Technical Contact:			
Name:	_____		
Address 1:	_____	**Address 2**	_____
City:	_____	**State:**	_____
ZIP:	_____	**Email:**	_____
Tel:	_____	**Fax:**	_____

Section 3. Training, Testing and Checking Considerations		
Area/Function/Maneuver	**Requested**	**Remarks**
Private Pilot - Training / Checks: (142)	☐	_____
Commercial Pilot - Training /Checks:(142)	☐	_____
Multi-Engine Rating - Training / Checks (142)	☐	_____
Instrument Rating -Training / Checks (142)	☐	_____
Type Rating - Training / Checks (135/121/142)	☐	_____
Proficiency Checks (135/121/142)	☐	_____

Attachment 4 to Appendix A to Part 60—
Figure A4B – Sample Letter , Request for Initial, Upgrade, or Reinstatement Evaluation
Attachment: FSTD Information Form
INFORMATION

CAT I: (RVR 2400/1800 ft. DH200 ft)	☐	_____
CAT II: (RVR 1200 ft. DH 100 ft)	☐	_____
CAT III * (lowest minimum) _____ RVR _____ ft. * State CAT III (≤ 700 ft.), CAT IIIb (≤ 150 ft.), or CAT IIIc (0 ft.)	☐	_____
Circling Approach	☐	_____
Windshear Training:	☐	_____
Windshear Training IAW 121.409(d) (121 Turbojets Only)	☐	_____
Generic Unusual Attitudes and Recoveries within the Normal Flight Envelope	☐	_____
Specific Unusual Attitudes Recoveries	☐	_____
Auto-coupled Approach/Auto Go Around	☐	_____
Auto-land / Roll Out Guidance	☐	_____
TCAS/ACAS I / II	☐	_____
WX-Radar	☐	_____
HUD	☐	_____
HGS	☐	_____
EFVS	☐	_____
Future Air Navigation Systems	☐	_____
GPWS / EGPWS	☐	_____
ETOPS Capability	☐	_____
GPS	☐	_____
SMGCS	☐	_____
Helicopter Slope Landings	☐	_____
Helicopter External Load Operations	☐	_____
Helicopter Pinnacle Approach to Landings	☐	_____
Helicopter Night Vision Maneuvers	☐	_____
Helicopter Category A Takeoffs	☐	_____

Attachment 4 to Appendix A to Part 60—
Figure A4C – Sample Letter of Compliance
INFORMATION

(Date)

Mr. (Name of Training Program Approval Authority):
(Name of FAA FSDO)
(Address)
(City/State/Zip)

Dear Mr. (Name of TPAA):

RE: Letter of Compliance

(Operator Sponsor Name) requests evaluation of our (Aircraft Type) FFS for Level (__) qualification. The (FFS Manufacturer Name) FFS with (Visual System Manufacturer Name/Model) system is fully defined on the FFS Information page of the accompanying Qualification Test Guide (QTG). We have completed the tests of the FFS and certify that it meets all applicable requirements of FAR parts 121, 125, or 135), and the guidance of (AC 120-40B or 14 CFR Part 60). Appropriate hardware and software configuration control procedures have been established. Our Pilot(s), (Name(s)), who are qualified on (Aircraft Type) aircraft have assessed the FFS and have found that it conforms to the (Operator/Sponsor) (Aircraft Type) flight deck configuration and that the simulated systems and subsystems function equivalently to those in the aircraft. The above named pilot(s) have also assessed the performance and the flying qualities of the FFS and find that it represents the respective aircraft.

(Added Comments may be placed here)

Sincerely,
(Sponsor Representative)

cc:
FAA, National Simulator Program

Attachment 4 to Appendix A to Part 60—
Figure A4D – Sample Qualification Test Guide Cover Page
INFORMATION

SPONSOR NAME

SPONSOR ADDRESS

FAA QUALIFICATION TEST GUIDE

(SPECIFIC AIRPLANE MODEL)
for example
Stratos BA797-320A

(Type of Simulator)

(Simulator Identification Including Manufacturer, Serial Number, Visual System Used)

(Simulator Level)

(Qualification Performance Standard Used)

(Simulator Location)

FAA Initial Evaluation

Date: _____

_____ Date: _____
(Sponsor)

_____ Date: _____
Manager, National
Simulator Program, FAA

Attachment 4 to Appendix A to Part 60—
Figure A4E – Sample Statement of Qualification - Certificate
INFORMATION

Federal Aviation Administration

National Simulator Program

Certificate of Qualification

This is to certify that representatives of the National Simulator Program
Completed an evaluation of the

Go-Fast Airlines

Farnsworth Z-100 Full Flight Simulator

FAA Identification Number 999

And pursuant to 14 CFR Part 60 found it to meet its original qualification basis, AC 120-40B (MM/DD/YY)

The Master Qualification Test Guide and the attached
Configuration List and Restrictions List
Provide the Qualification Basis for this device to operate at

Level D

Until April 30, 2010

Unless sooner rescinded or extended by the National Simulator Program Manager

March 15, 2009	*B. Williamson*
(date)	(for the NSPM)

Attachment 4 to Appendix A to Part 60—
Figure A4F – Sample Statement of Qualification; Configuration List
INFORMATION

STATEMENT OF QUALIFICATION
CONFIGURATION LIST

Date: ____			
Section 1. FSTD Information and Characteristics			
Sponsor Name:	____	**FSTD Location:**	
Address:	____ ____	**Physical Address:**	____ ____
City:	____	**City:**	____
State:	____	**State:**	____
Country:	____	**Country:**	____
ZIP:	____	**ZIP:**	____
Manager	____		
Sponsor ID No: (Four Letter FAA Designator)	____	**Nearest Airport:** (Airport Designator)	____
Type of Evaluation Requested:	☐ **Initial** ☐ **Upgrade** ☐ **Continuing Qualification** ☐ **Special** ☐ **Reinstatement**		
Aircraft Make/model/series:	____		
Initial Qualification: (If Applicable)	**Date:** ____ **Level** ____ MM/DD/YYYY	**Manufacturer's Identification or Serial Number**	____
Upgrade Qualification: (If Applicable)	**Date:** ____ **Level** ____ MM/DD/YYYY	☐ **eMQTG**	
Qualification Basis: ____	☐ **A** ☐ **B** ☐ **Interim C** ☐ **C** ☐ **D** ☐ **6** ☐ **7** ☐ **Provisional Status**		
Other Technical Information:			
FAA FSTD ID No: (If Applicable)	____	**FSTD Manufacturer:**	____
Convertible FSTD:	☐ **Yes:**	**Date of Manufacture:**	____ MM/DD/YYYY
Related FAA ID No. (If Applicable)	____ ____ ____	**Sponsor FSTD ID No:**	____
Engine model(s) and data revision: ____		**Source of aerodynamic model:** ____	
FMS identification and revision level: ____		**Source of aerodynamic coefficient data:** ____	
Visual system manufacturer/model: ____		**Aerodynamic data revision number:** ____	
Flight control data revision: ____		**Visual system display:** ____	
Mot ion system manufacturer/type: ____		**FSTD computer(s) identification:** ____	
National Aviation Authority (NAA): (If Applicable)	____		
NAA FSTD ID No:	____	**Last NAA Evaluation Date:**	____
NAA Qualification Level:	____		
NAA Qualification Basis:	____		

Attachment 4 to Appendix A to Part 60—
Figure A4F – Sample Statement of Qualification; Configuration List
INFORMATION

Visual System Manufacturer and Type:	_____	**FSTD Seats Available:** ___	**Motion System Manufacturer and Type:**	_____:
Aircraft Equipment:	**Engine Type(s):** _____ _____	**Flight Instrumentation:** ☐ EFIS ☐ HUD ☐ HGS ☐ EFVS ☐ TCAS ☐ GPWS ☐ Plain View ☐ GPS ☐ FMS Type: ___ ☐ WX Radar ☐ Other: ___		**Engine Instrumentation:** ☐ EICAS ☐ FADEC ☐ Other: ___

Airport Models:	3.6.1 _____ Airport Designator	3.6.2_____ Airport Designator	3.6.3 _____ Airport Designator
Circle to Land:	3. 7.1 _____ Airport Designator	3. 7.2_____ Approach	3. 7.3 _____ Landing Runway
Visual Ground Segment	3.8.1 _____ Airport Designator	3.8 .2_____ Approach	3. 8.3 _____ Landing Runway

Section 2. Supplementary Information

FAA Training Program Approval Authority:		☐ **POI** ☐ **TCPM** ☐ **Other:** _____	
Name:	_____	**Office:**	_____
Tel:	_____	**Fax:**	_____
Email:	_____		

FSTD Scheduling Person:			
Name:	_____		
Address 1:	_____	**Address 2**	_____
City:	_____	**State:**	_____
ZIP:	_____	**Email:**	_____
Tel:	_____	**Fax:**	_____

FSTD Technical Contact:			
Name:	_____		
Address 1:	_____	**Address 2**	_____
City:	_____	**State:**	_____
ZIP:	_____	**Email:**	_____
Tel:	_____	**Fax:**	_____

Section 3. Training, Testing and Checking Considerations

Area/Function/Maneuver	**Requested**	**Remarks**
Private Pilot - Training / Checks: (142)	☐	_____
Commercial Pilot - Training /Checks:(142)	☐	_____
Multi-Engine Rating - Training / Checks (142)	☐	_____

Attachment 4 to Appendix A to Part 60—
Figure A4F – Sample Statement of Qualification; Configuration List
INFORMATION

Instrument Rating -Training / Checks (142)	☐	_____
Type Rating - Training / Checks (135/121/142)	☐	_____
Proficiency Checks (135/121/142)	☐	_____
CAT I: (RVR 2400/1800 ft. DH200 ft)	☐	_____
CAT II: (RVR 1200 ft. DH 100 ft)	☐	_____
CAT III * (lowest minimum) _____ RVR _____ ft. * State CAT III (≤ 700 ft.), CAT IIIb (≤ 150 ft.), or CAT IIIc (0 ft.)	☐	_____
Circling Approach	☐	_____
Windshear Training:	☐	_____
Windshear Training IAW 121.409(d) (121 Turbojets Only)	☐	_____
Generic Unusual Attitudes and Recoveries within the Normal Flight Envelope	☐	_____
Specific Unusual Attitudes Recoveries	☐	_____
Auto-coupled Approach/Auto Go Around	☐	_____
Auto-land / Roll Out Guidance	☐	_____
TCAS/ACAS I / II	☐	_____
WX-Radar	☐	_____
HUD	☐	_____
HGS	☐	_____
EFVS	☐	_____
Future Air Navigation Systems	☐	_____
GPWS / EGPWS	☐	_____
ETOPS Capability	☐	_____
GPS	☐	_____
SMGCS	☐	_____
Helicopter Slope Landings	☐	_____
Helicopter External Load Operations	☐	_____
Helicopter Pinnacle Approach to Landings	☐	_____
Helicopter Night Vision Maneuvers	☐	_____
Helicopter Category A Takeoffs	☐	_____

Attachment 4 to Appendix A to Part 60—
Figure A4G – Sample Statement of Qualification – List of Qualified Tasks
INFORMATION

STATEMENT of QUALIFICATION

List of Qualified Tasks

Go Fast Airline Training -- Farnsworth Z-100 -- Level D -- FAA ID# 999

The FFS is qualified to perform all of the Maneuvers, Procedures, Tasks, and Functions Listed in Appendix A, Attachment 1, Table A1B, Minimum FFS Requirements In Effect on [mm/dd/yyyy] except for the following listed Tasks or Functions.

Qualified for all tasks in Table A1B, for which the sponsor has requested qualification, except for the following: 3.e(1)(i) NDB approach 3.f. Recovery from Unusual Attitudes 4.3. Circling Approach
Additional tasks for which this FFS is qualified (i.e., in addition to the list in Table A1B) 1. Enhanced Visual System 2. Windshear Training IAW Section 121.409(d).
The airport visual models evaluated for qualification at this level are: 1. Atlanta Hartsfield International Airport (KATL) 2. Miami International Airport (KMIA) 3. Dallas/Ft. Worth Regional Airport (KDFW)

Attachment 4 to Appendix A to Part 60—
Figure A4H – Sample Continuing Qualification Evaluation Requirements Page
INFORMATION

Continuing Qualification Evaluation Requirements *Completed at conclusion of Initial Evaluation*	
Continuing qualification Evaluations to be conducted each _(fill in)__ months Allotting _____ hours of FTD time. Signed: _____ NSPM / Evaluation Team Leader	Continuing qualification evaluations are due as follows: _(month)__ and __(month)_ and __(month)_ (enter or strike out, as appropriate) _____ Date

Revision:	
Based on (enter reasoning):	
Continuing qualification Evaluations are to be conducted each _(fill in)__ months. Allotting _____ hours. Signed: _____ NSPM / Evaluation Team Leader	Continuing qualification evaluations are due as follows: _(month)__ and __(month)_ and __(month)_ (enter or strike out, as appropriate) _____ Date

Revision:	
Based on (enter reasoning):	
Continuing qualification Evaluations are to be conducted each _(fill in)__ months. Allotting _____ hours. Signed: _____ NSPM / Evaluation Team Leader	Continuing qualification evaluations are due as follows: _(month)__ and __(month)_ and __(month)_ (enter or strike out, as appropriate) _____ Date

(Repeat as Necessary)

Attachment 4 to Appendix A to Part 60—
Figure A4I – Sample MQTG Index of Effective FFS Directives
INFORMATION

Index of Effective FSTD Directives Filed in this Section			
Number	**Effective Date**	**Date of Notification**	**Details**

Continue as Necessary....

Attachment 5 to Appendix A to Part 60—
Simulator Qualification Requirements For Windshear Training Program Use

Begin QPS Requirements

1. Applicability

This attachment applies to all simulators, regardless of qualification level, that are used to satisfy the training requirements of an FAA- approved low-altitude windshear flight training program, or any FAA-approved training program that addresses windshear encounters.

2. Statement of Compliance and Capability (SOC)

a. The sponsor must submit an 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).

b. 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.

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 ±5°.

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 ''nonsurvivable'' scenario of paragraph 3.b.(2) of this attachment, that involve operational elements of the simulated airplane, must reflect the dispatch limitations of the airplane.

c. Be available for use in the FAA-approved windshear flight training program.

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 5 of this attachment.

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 attachment, must be made a part of the MQTG.

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, N_1, 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.

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. Qualification Test Guide

a. All QTG material must be forwarded to the NSPM.

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 2, 3, 4, and 5 of this attachment.

End QPS Requirements

Begin Information

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 NSPM's discretion.

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.

10. Demonstration Repeatability

For the purposes of demonstration repeatability, it is recommended that the simulator be flown by means of the simulator's autodrive function (for those simulators that have autodrive capability) during the demonstrations.

End Information

Attachment 6 to Appendix A to Part 60—FSTD Directives Applicable to Airplane Flight Simulators

Flight Simulation Training Device (FSTD) Directive

FSTD Directive 1. Applicable to all Full Flight Simulators (FFS), regardless of the original qualification basis and qualification date (original or upgrade), having Class II or Class III airport models available.

Agency: Federal Aviation Administration (FAA), DOT

Action: This is a retroactive requirement to have all Class II or Class III airport models meet current requirements.

Summary: Notwithstanding the authorization listed in paragraph 13b in Appendices A and C of this part, this FSTD Directive requires each certificate holder to ensure that by May 30, 2009, except for the airport model(s) used to qualify the simulator at the designated level, each airport model used by the certificate holder's instructors or evaluators for training, checking, or testing under this chapter in an FFS, meets the definition of a Class II or Class III airport model as defined in 14 CFR part 60. The completion of this requirement will not require a report, and the method used for keeping instructors and evaluators apprised of the airport models that meet Class II or Class III requirements on any given simulator is at the option of the certificate holder whose employees are using the FFS, but the method used must be available for review by the TPAA for that certificate holder.

Dates: FSTD Directive 1 becomes effective on May 30, 2008.

For Further Information Contact: National Simulator Program Manager, Air Transportation Division, AFS–205, P.O. Box 20636, Atlanta, Georgia 30320: telephone: (404) 474–5620; fax: (404) 474–5656.

Specific Requirements:

1. Part 60 requires that each FSTD be:

a. Sponsored by a person holding or applying for an FAA operating certificate under Part 119, Part 141, or Part 142, or holding or applying for an FAA-approved training program under Part 63, Appendix C, for flight engineers, and

b. Evaluated and issued an SOQ for a specific FSTD level.

2. FFSs also require the installation of a visual system that is capable of providing an out-of-the-flight-deck view of airport models. However, historically these airport models were not routinely evaluated or required to meet any standardized criteria. This has led to qualified simulators containing airport models being used to meet FAA-approved training, testing, or checking requirements with potentially incorrect or inappropriate visual references.

3. To prevent this from occurring in the future, by May 30, 2009, except for the airport model(s) used to qualify the simulator at the designated level, each certificate holder must assure that each airport model used for training, testing, or checking under this chapter in a qualified FFS meets definition of a Class II or Class III airport model as defined in Appendix F of this part.

4. These references describe the requirements for visual scene management and the minimum distances from which runway or landing area features must be visible for all levels of simulator. The airport model must provide, for each ''in-use runway'' or ''in-use landing area,'' runway or landing area surface and markings, runway or landing area lighting, taxiway surface and markings, and taxiway lighting. Additional requirements include correlation of the v airport models with other aspects of the airport environment, correlation of the aircraft and associated equipment, scene quality assessment features, and the control of these models the instructor must be able to exercise.

5. For circling approaches, all requirements of this section apply to the runway used for the initial approach and to the runway of intended landing.

6. The details in these models must be developed using airport pictures, construction drawings and maps, or other similar data, or developed in accordance with published regulatory material. However, this FSTD DIRECTIVE 1 does not require that airport models contain details that are beyond the initially designed capability of the visual system, as currently qualified. The recognized limitations to visual systems are as follows:

a. Visual systems not required to have 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.
(4) Redifusion SP1, SP1T, and SP2.

b. Visual 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. Visual systems not required to have accurate taxiway edge lighting are:

(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).

7. A copy of this Directive must be filed in the MQTG in the designated FSTD Directive Section, and its inclusion must be annotated on the Index of Effective FSTD Directives chart. See Attachment 4, Appendices A through D for a sample MQTG Index of Effective FSTD Directives chart.

Flight Simulation Training Device (FSTD) Directive

FSTD Directive 2. Applicable to all airplane Full Flight Simulators (FFS), regardless of the original qualification basis and qualification date (original or upgrade), used to conduct full stall training, upset recovery training, airborne icing training, and other flight training tasks as described in this Directive.

Agency: Federal Aviation Administration (FAA), DOT.

Action: This is a retroactive requirement for any FSTD being used to obtain training, testing, or checking credit in an FAA approved flight training program to meet current FSTD evaluation requirements for the specific training maneuvers as defined in this Directive.

Summary: Notwithstanding the authorization listed in paragraph 13b in Appendix A of this Part, this FSTD Directive requires that each FSTD sponsor conduct additional subjective and objective testing, conduct required modifications, and apply for additional FSTD qualification under § 60.16 to support continued qualification of the following flight training tasks where training, testing, or checking credit is being sought in a selected FSTD being used in an FAA approved flight training program:

a. Recognition of and Recovery from a Full Stall
b. Upset Recognition and Recovery
c. Airborne Icing (Engine and Airframe Ice Accretion)
d. Takeoff and Landing with Gusting Crosswinds
e. Recovery from a Bounced Landing

The FSTD sponsor may elect to apply for additional qualification for any, all, or none of the above defined training tasks for a particular FSTD. After [THE FAA WILL INSERT DATE 3 years FROM EFFECTIVE DATE OF THE FINAL RULE PUBLISHED IN THE **Federal Register**], any FSTD used to conduct the above training tasks must be evaluated and issued additional qualification by the National Simulator Program Manager (NSPM) as defined in this Directive.

Dates: FSTD Directive 2 becomes effective on [THE FAA WILL INSERT THE EFFECTIVE DATE OF THE FINAL RULE PUBLISHED IN THE **FEDERAL REGISTER**].

For Further Information Contact: Larry McDonald, Air Transportation Division/ National Simulator Program Branch, AFS–205, Federal Aviation Administration, P.O. Box 20636, Atlanta, GA 30320; telephone (404) 474–5620; email *larry.e.mcdonald@faa.gov*.

Specific Requirements

1. Part 60 requires that each FSTD be:

a. Sponsored by a person holding or applying for an FAA operating certificate under Part 119, Part 142, or Part 142, or holding or applying for an FAA-approved training program under Part 63, Appendix C, for flight engineers, and

b. Evaluated and issued a Statement of Qualification (SOQ) for a specific FSTD level.

2. The evaluation criteria contained in this Directive is intended to address specific training tasks that require additional evaluation to ensure adequate FSTD fidelity.

3. The requirements described in this Directive define additional qualification criteria for specific training tasks that are applicable only to those FSTDs that will be utilized to obtain training, testing, or checking credit in accordance with an FAA approved flight training program. In order to obtain additional qualification for the tasks described in this Directive, FSTD sponsors must request additional qualification in accordance with § 60.16 and the requirements of this Directive. FSTDs that are found to meet the requirements of this Directive will have their Statement of Qualification (SOQ) amended to reflect the additional training tasks that the FSTD has been qualified to conduct. The additional qualification requirements as defined in this Directive are divided into the following training tasks:

a. Section I—Additional Qualification Requirements for Full Stall Training Tasks
b. Section II—Additional Qualification Requirements for Upset Recognition and Recovery Training Tasks
c. Section III—Additional Qualification Requirements for Airborne Engine and Airframe Icing Training Tasks
d. Section IV—Additional Qualification Requirements for Takeoff and Landing Tasks in Gusting Crosswinds
e. Section V—Additional Qualification Requirements for Bounced Landing Training Tasks

4. A copy of this Directive (along with all required Statements of Compliance and objective test results) must be filed in the MQTG in the designated FSTD Directive Section, and its inclusion must be annotated on the Index of Effective FSTD Directives chart. See Attachment 4, Appendices A through D for a sample MQTG Index of Effective FSTD Directives chart.

Section I—Evaluation Requirements for Full Stall Training Tasks

1. This section applies to previously qualified Level C and Level D FSTDs being utilized to obtain training, testing, or checking credits at angles of attack beyond the first indication of a stall (such as stall warning system activation, stick shaker, etc.). Qualification of full stall maneuvers for Level A and Level B FSTDs in accordance with this Directive may be considered where the FSTD's motion and vibration cueing systems have been evaluated to provide adequate stall recognition and recovery cues to conduct the specific stall maneuvers described in Table A1A, Section 2.1.7.S.

2. The evaluation requirements in this Directive are intended to validate FSTD fidelity at angles of attack sufficient to identify the stall, to demonstrate aircraft performance degradation in the stall, and to train recovery techniques from a fully stalled flight condition.

3. This Directive contains additional objective and subjective testing that exceed the evaluation requirements of previously qualified FSTDs. Where aerodynamic modeling data and/or validation data is not available or insufficient to fully meet the requirements of this Directive, the NSPM may restrict FSTD qualification to certain stall maneuvers where adequate validation data exists.

4. By [THE FAA WILL INSERT DATE 3 years FROM EFFECTIVE DATE OF THE FINAL RULE PUBLISHED IN THE **Federal Register**], any FSTD being used to obtain training, testing, or checking credits for full stall training tasks in an FAA approved training program must be evaluated by the FSTD sponsor in accordance with the following sections of Appendix A of this Part:

a. Table A1A, General Requirements, Section 2.1.7.S (High Angle of Attack Maneuvers)
b. Table A2A, Objective Testing Requirements, Test 2.a.10 (Stick Pusher Force Calibration) [where applicable]
c. Table A2A, Objective Testing Requirements, Test 2.c.8.b (Stall Characteristics)
d. Table A3A, Functions and Subjective Testing Requirements, Test 6.a.2 (High Angle of Attack Maneuvers)
e. Attachment 7, Additional QPS Requirements for Stall Maneuver Evaluation

5. The validation data for the required stall characteristics tests may be derived from an approved engineering simulation data source or other data source acceptable to the FAA. An SOC must be provided by the validation data provider that the engineering simulation has been evaluated by an appropriate SME pilot in accordance with Table A1A, Section 2.1.7.S and Attachment 7. Where no flight test or engineering simulation validation data is available, baseline objective tests of the FSTD's performance may be acceptable where accompanied by an SME evaluation of each required objective test conditions.

6. Where qualification is being sought to conduct full stall training tasks in accordance with this Directive, the FSTD Sponsor must conduct the required evaluations and modifications as prescribed in this Directive and report compliance to the NSPM in accordance with § 60.23 using the NSP's standardized FSTD Sponsor Notification Form. At a minimum, this form 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 (Aerodynamics and Stick Pusher System Modeling)—See Table A1A, Section 2.1.7.S and Attachment 7
c. Statement of Compliance (SME Pilot Evaluation)—See Table A1A, Section 2.1.7.S and Attachment 7
d. Copies of the required objective test results as described above in sections 4.b. and 4.c.

7. The NSPM will review each submission to determine if the requirements of this Directive have been met and respond to the FSTD Sponsor as described in § 60.23(c). This response, along with any noted restrictions, may serve as an interim update to the FSTD's Statement of Qualification (SOQ) until such time that a permanent change is made to the SOQ at the FSTD's next scheduled evaluation.

Section II—Evaluation Requirements for Upset Recovery Training Tasks

1. This section applies to previously qualified FSTDs being utilized to obtain training, testing, or checking credits for upset recognition and recovery training tasks as defined in Appendix A, Table A1A, Section 2.1.6.S. of this Part. Qualification of upset recovery maneuvers for Level A and Level B FSTDs in accordance with this Directive may be considered where the FSTD's motion and vibration cueing systems have been evaluated to provide adequate cues to conduct the

specific upset recovery maneuvers described in Table A1A, Section 2.1.6.S.

2. The requirements contained in this section are intended to define minimum standards for evaluating an FSTD for use in upset recognition and recovery training maneuvers that may exceed an aircraft's normal flight envelope. These standards include the evaluation of qualified training maneuvers against the FSTD's validation envelope and providing the instructor with minimum feedback tools for the purpose of determining if a training maneuver is conducted within FSTD validation limits and the aircraft's structural/performance limitations.

3. This Directive contains additional objective and subjective testing that exceeds the evaluation requirements of previously qualified FSTDs. Where aerodynamic modeling data and/or validation data is not available or insufficient to meet the requirements of this Directive, the NSPM may limit additional qualification to certain upset recovery maneuvers where adequate validation data exists.

4. By [THE FAA WILL INSERT DATE 3 years FROM EFFECTIVE DATE OF THE FINAL RULE PUBLISHED IN THE **Federal Register**], any FSTD being used to obtain training, testing, or checking credit for upset recognition and recovery training tasks in an FAA approved flight training program must be evaluated by the FSTD sponsor in accordance with the following sections of Appendix A of this Part:

a. Table A1A, General Requirements, Section 2.1.6.S. (Upset Recognition and Recovery)
b. Table A3A, Functions and Subjective Testing, Test 5.b.15. (Upset Recovery and Recovery Maneuvers)
c. Attachment 7, Additional QPS Requirements for Upset Recognition and Recovery Maneuver Evaluation

6. Where qualification is being sought to conduct upset recognition and recovery training tasks in accordance with this Directive, the FSTD Sponsor must conduct the required evaluations and modifications as prescribed in this Directive and report compliance to the NSPM in accordance with § 60.23 using the NSP's standardized FSTD Sponsor Notification Form. At a minimum, this form 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 (FSTD Validation Envelope)—See Table A1A, Section 2.1.6.S and Attachment 7
c. A confirmation statement that the modified FSTD has been subjectively evaluated by a qualified pilot as described in § 60.16(a)(1)(iii).

7. The NSPM will review each submission to determine if the requirements of this Directive have been met and respond to the FSTD Sponsor as described in § 60.23(c). Additional NSPM conducted FSTD evaluations may be required before the modified FSTD is placed into service. This response, along with any noted restrictions, will serve as an interim update to the FSTD's Statement of Qualification (SOQ) until such time that a permanent change is made to the SOQ at the FSTD's next scheduled evaluation.

Section III—Evaluation Requirements for Engine and Airframe Icing Training Tasks

1. This section applies to previously qualified Level C and Level D FSTDs being utilized to obtain training, testing, or checking credits in maneuvers that demonstrate the effects of engine and airframe ice accretion.

2. The evaluation requirements in this section are intended to supersede and improve upon existing Level C and Level D FSTD 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.

3. This Directive contains additional subjective testing that exceeds the evaluation requirements of previously qualified FSTDs. Where aerodynamic modeling data is not available or insufficient to meet the requirements of this Directive, the NSPM may limit qualified engine and airframe icing maneuvers where sufficient aerodynamic modeling data exists.

4. By [THE FAA WILL INSERT DATE 3 years FROM EFFECTIVE DATE OF THE FINAL RULE PUBLISHED IN THE **Federal Register**], any FSTD being used to conduct training tasks in engine and airframe icing must be evaluated by the FSTD sponsor in accordance with the following sections of Appendix A of this Part:

a. Table A1A, General Requirements, Section 2.1.5.S. (Engine and Airframe Icing)
b. Attachment 7, Additional QPS Requirements for Engine and Airframe Icing Evaluation (Paragraphs 1, 2, and 3). Objective demonstration testing is not required for previously qualified FSTDs.

5. Where continued qualification is being sought to conduct engine and airframe icing training tasks in accordance with this Directive, the FSTD Sponsor must conduct the required evaluations and modifications as prescribed in this Directive and report compliance to the NSPM in accordance with § 60.23 using the NSP's standardized FSTD Sponsor Notification Form. At a minimum, this form 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 (Ice Accretion Model)—See Table A1A, Section 2.1.5.S and Attachment 7
c. A confirmation statement that the modified FSTD has been subjectively evaluated by a qualified pilot as described in § 60.16(a)(1)(iii).

6. The NSPM will review each submission to determine if the requirements of this Directive have been met and respond to the FSTD Sponsor as described in § 60.23(c). Additional NSPM conducted FSTD evaluations may be required before the modified FSTD is placed into service. This response, along with any noted restrictions, will serve as an interim update to the FSTD's Statement of Qualification (SOQ) until such time that a permanent change is made to the SOQ at the FSTD's next scheduled evaluation.

Section IV—Evaluation Requirements for Gusting Crosswinds During Takeoff and Landing

1. This section applies to previously qualified FSTDs that will be utilized to obtain training, testing, or checking credits in takeoff and landing tasks in gusting crosswinds 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.

2. The evaluation requirements in this section are intended to introduce new evaluation requirements for gusting crosswinds during takeoff and landing training tasks and contains additional subjective testing that exceeds the evaluation requirements of previously qualified FSTDs.

3. By [THE FAA WILL INSERT DATE 3 years FROM EFFECTIVE DATE OF THE FINAL RULE PUBLISHED IN THE **Federal Register**], any FSTD that is utilized to conduct gusting crosswind takeoff and landing training tasks must be evaluated by the FSTD sponsor in accordance with the following sections of Appendix A of this Part:

a. Table A1A, General Requirements, Section 3.1.S.(2) (Ground Handling Characteristics)
b. Table A1A, General Requirements, Section 11.4.R.(1) (Atmosphere—Instructor Controls, Gusting Crosswind)
c. Table A3A, Functions and Subjective Testing Requirements, Test 3.a.3 (Takeoff, Crosswind—Maximum Demonstrated and Gusting Crosswind)
d. Table A3A, Functions and Subjective Testing Requirements, Test 8.d. (Approach and landing with crosswind—Maximum Demonstrated and Gusting Crosswind)

4. Where qualification is being sought to conduct gusting crosswind training tasks in accordance with this Directive, the FSTD Sponsor must conduct the required evaluations and modifications as prescribed in this Directive and report compliance to the NSPM in accordance with § 60.23 using the NSP's standardized FSTD Sponsor Notification Form. At a minimum, this form 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 Table A1A, Section 11.4.R.
c. A confirmation statement that the modified FSTD has been subjectively evaluated by a qualified pilot as described in § 60.16(a)(1)(iii).

5. The NSPM will review each submission to determine if the requirements of this Directive have been met and respond to the

FSTD Sponsor as described in § 60.23(c). Additional NSPM conducted FSTD evaluations may be required before the modified FSTD is placed into service. This response, along with any noted restrictions, will serve as an interim update to the FSTD's Statement of Qualification (SOQ) until such time that a permanent change is made to the SOQ at the FSTD's next scheduled evaluation.

Section V—Evaluation Requirements for Bounced Landing Recovery Training Tasks

1. This section applies to previously qualified FSTDs that will be utilized 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.

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.

3. By [THE FAA WILL INSERT DATE 3 years FROM EFFECTIVE DATE OF THE FINAL RULE PUBLISHED IN THE **Federal Register**], any FSTD that is utilized to conduct bounced landing training tasks must be evaluated by the FSTD sponsor in accordance with the following sections of Appendix A of this Part:

a. Table A1A, General Requirements, Section 3.1.S.(1) (Ground Reaction Characteristics)
b. Table A3A, Functions and Subjective Testing Requirements, Test 9.e. (Missed Approach—Bounced Landing)

4. Where qualification is being sought to conduct bounced landing training tasks in accordance with this Directive, the FSTD Sponsor must conduct the required evaluations and modifications as prescribed in this Directive and report compliance to the NSPM in accordance with § 60.23 using the NSP's standardized FSTD Sponsor Notification Form. At a minimum, this form 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. A confirmation statement that the modified FSTD has been subjectively evaluated by a qualified pilot as described in § 60.16(a)(1)(iii).

5. The NSPM will review each submission to determine if the requirements of this Directive have been met and respond to the FSTD Sponsor as described in § 60.23(c). Additional NSPM conducted FSTD evaluations may be required before the modified FSTD is placed into service. This response, along with any noted restrictions, will serve as an interim update to the FSTD's Statement of Qualification (SOQ) until such time that a permanent change is made to the SOQ at the FSTD's next scheduled evaluation.

Attachment 7 to Appendix A to Part 60—Additional Simulator Qualification Requirements for Stall, Upset Recognition and Recovery, and Engine and Airframe Icing Training Tasks

Begin QPS Requirements

High Angle of Attack Model Evaluation (Table A1A, Section 2.1.7.S.)

1. Applicability: This attachment applies to all simulators that are used to satisfy training requirements for full stall maneuvers that are conducted at angles of attack beyond the activation of the stall warning system. This attachment is not applicable for those FSTDs that are only qualified for approach to stall maneuvers that cease after recovery from 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, respectively.

2. General Requirements: The requirements for high angle of attack modeling are intended to provide aircraft specific recognition cues and performance and handling qualities of a developing stall through the stall break and recovery. It is recognized, however, that strict time-history-based evaluation against flight test data may not adequately validate the aerodynamic model in an unstable flight regime, such as stalled flight, particularly in cases where significant deviations are seen in the aircraft's stability and control. As a result, the objective testing requirements defined in Table A2A do not prescribe strict tolerances on any parameter at angles of attack beyond the stall angle of attack. In lieu of mandating objective tolerances to flight test data at angles of attack at and beyond the stall, a Statement of Compliance (SOC) will be required to define the source data and methods used to develop the stall aerodynamic model which incorporates defined stall characteristics as applicable for the simulated aircraft type. In this flight regime (at angles of attack above the stall angle of attack), the aerodynamic modeling is expected to simulate aircraft ''type representative'' post-stall behavior to the extent that the training objectives can be accomplished. This SOC must also include verification that the stall model has been evaluated by a subject matter expert (SME) pilot acceptable to the FAA.

3. Statement of Compliance (Aerodynamic Model): At a minimum, the following must be addressed in the SOC:

a. Source Data and Modeling Methods: The SOC must identify the sources of data used to develop the aerodynamic model. Of particular interest is a mapping of test points in the form of alpha/beta envelope plot for a minimum of flaps up and flaps down 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 limited data is available to model and/or validate the stall characteristics (e.g. safety issues involving the collection flight test data), the data provider is expected to make a reasonable attempt to develop a stall model through analytical methods and utilization of the best available data.

b. Validity Range: The FSTD Sponsor must declare the range of angle of attack and sideslip where the aerodynamic model remains valid. For full (aerodynamic) stall training tasks, model validation and/or analysis should be conducted through at least 10 degrees beyond the critical angle of attack. In cases where training is limited to the activation of a stall identification system (stick pusher), model validation may be conducted at a lower angle of attack range, but the FSTD Sponsor must specify and restrict the use of the FSTD to those maneuvers that have been appropriately validated.

c. Model Characteristics: Within the declared range of model validity, the SOC must address and the aerodynamic model must incorporate the following typical stall characteristics where applicable by aircraft type:

i. Degradation in static/dynamic lateral-directional stability
ii. Degradation in control response (pitch, roll, yaw)
iii. Uncommanded roll response
iv. Apparent randomness or non-repeatability
v. Changes in pitch stability
vi. Stall hysteresis
vii. Mach effects
viii. Stall buffet

An overview of the methodology used to address these features must be provided.

4. Statement of Compliance (SME Evaluation): The stall model must be evaluated by a subject matter expert (SME) pilot with knowledge of the cues necessary to accomplish the required training objectives and with experience in conducting stalls in the type of aircraft being simulated. In cases where such an SME pilot is not available, a pilot with experience in an aircraft with similar stall characteristics may be utilized. The SME pilot conducting the stall model evaluation must be acceptable to the NSPM. This evaluation may be conducted in the sponsor's FSTD or in an ''audited'' engineering simulation. The engineering simulation can then be used to provide objective checkout cases and subjective evaluation guidance material to the FSTD sponsor/operator for evaluation of the implemented model on the Sponsor's FSTD.

Final evaluation and approval of the Sponsor's FSTD must be accomplished by an SME pilot with knowledge of the training requirements to conduct the stall training tasks. Where available, documentation, including checkout documentation from an acceptable data provider, AFM documentation, or other source documentation related to stall training tasks for the simulated aircraft should be utilized. Particular emphasis should be placed upon recognition cues of an impending aerodynamic stall (such as the stall buffet, lateral/directional instability, etc.), stall break (g-break, pitch break, roll off departure, etc.), response of aircraft automation (such as autopilot and auto throttles), and the necessary control input required to execute an immediate recovery from the stall.

Upset Recognition and Recovery Evaluation (Table A1A, Section 2.1.6.S.)

1. Applicability: This attachment applies to all simulators that are used to satisfy training requirements for upset recognition and recovery maneuvers. For the purposes of this attachment (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:

- Pitch attitude greater than 25 degrees nose up.
- Pitch attitude greater than 10 degrees nose down.
- Bank angles greater than 45 degrees.
- Within the above parameters, but flying at airspeeds inappropriate for the conditions.

FSTDs that will be used to conduct upset recognition and recovery training maneuvers in which the FSTD is either repositioned into an aircraft upset condition or an artificial stimulus (such as weather phenomena or system failures) is applied that could potentially result in a flightcrew entering an aircraft upset condition must be evaluated and qualified in accordance with this section.

2. General Requirements: The general requirement for upset recognition and recovery qualification in Table A1A defines three basic elements required for qualifying an FSTD for upset recognition and recovery maneuvers:

a. FSTD Validation Envelope: The FSTD validation envelope must be defined and utilized to determine if qualified upset recovery maneuvers can be executed while remaining within FSTD validation limits.

b. Instructor Feedback: In order to enhance the instructor's situational awareness, the FSTD must employ a method to provide a minimum set of feedback tools to determine if the FSTD remains within validation limits and the simulated aircraft remains within operating limits during a student's execution of an upset recovery maneuver.

c. Upset Scenarios: Where dynamic upset scenarios or aircraft system malfunctions are used to stimulate the FSTD into an aircraft upset condition, such external stimuli/malfunctions must be realistic and supported by data sources where available. Acceptable data sources may include studies of environmental phenomena, aircraft accident/incident data, aircraft manufacturer's data, or other relevant data sources.

3. Validation Envelopes: For the purposes of this attachment, the term ''flight envelope'' refers to the entire domain in which the FSTD is capable of being flown. This envelope can be further divided into three subdivisions (e.g. see Appendix 3–D of the *Airplane Upset Recovery Training Aid*):

- Flight Test Validated: 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 aerodynamic math model has been conformed to the flight test results, that portion of the math model can be considered to be within the Flight Test Validated region.
- Wind Tunnel and/or Analytical: This is the region of the flight envelope for which the FSTD has not been compared to flight test data, but for which there has been wind tunnel testing and/or the use of other reliable predictive methods (typically by the aircraft manufacturer) to define the aerodynamic model. Any extensions to the aerodynamic model that have been evaluated in accordance with the definition of a ''representative'' stall model (as described above in the stall maneuver section) must be clearly indicated. Within this region, there is moderate confidence that the simulator will respond similarly to the aircraft.
- 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 reduced confidence that the simulator will respond similarly to the aircraft. Brief excursions into this region may still retain a moderate confidence level in simulator fidelity; however, the instructor should be aware that the simulator's response may deviate from the actual aircraft.

4. Instructor Feedback Mechanism: For the instructor/evaluator to provide feedback to the student during URT maneuver training, additional information must be accessible that indicates the relative fidelity of the simulation, magnitude of student 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. Simulator Validation Envelope: The FSTD must employ a method to record the FSTD's expected level of fidelity with respect to the designed validation envelope. This may be displayed as an ''alpha/beta'' crossplot on the Instructor Operating System (IOS) or other alternate method acceptable to the FAA to clearly convey the simulator's expected fidelity level during the maneuver.

b. Flight Control Inputs: The FSTD must employ a method for the instructor/evaluator to assess the student's flight control input used to execute the upset recovery maneuver. Parameters which may not be easily assessed visually from the instructor station, such as rudder pedal displacement and control forces, must be included in this feedback mechanism.

c. Aircraft Operational Limits: The FSTD must employ a method to provide the instructor/evaluator with information concerning the aircraft operating limitations (such as normal load factor and airspeed limits found on a V-n diagram) that may affect the successful completion of the maneuver.

End QPS Requirements

Begin Information

An example FSTD ''alpha/beta'' envelope display and IOS feedback mechanism are shown below in Figure 1 and Figure 2.

Figure 1 – Example FSTD Alpha/Beta Envelope Plot

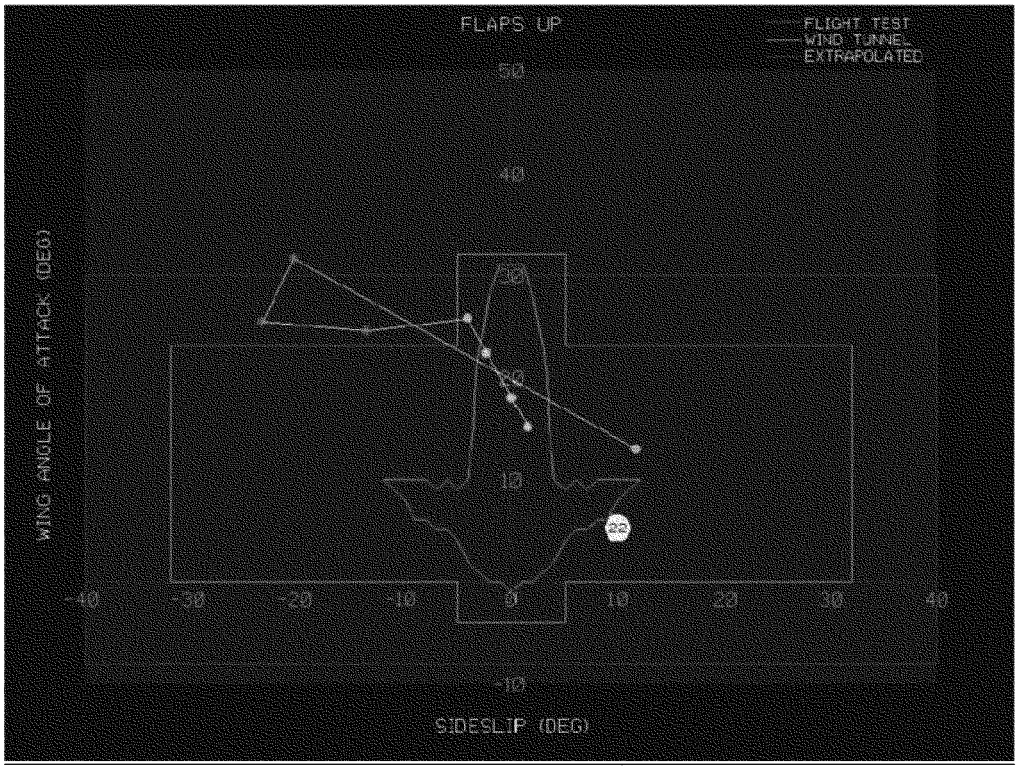
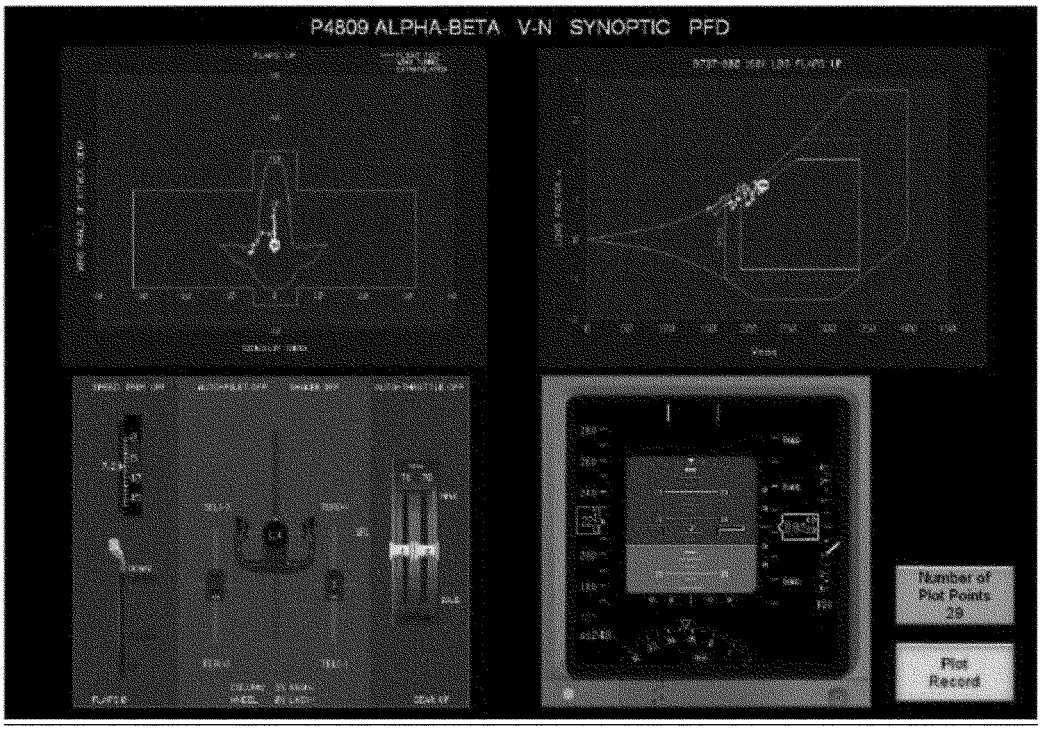


Figure 2 – Example IOS Instructor URT Feedback Display



End Information

Begin QPS Requirements

Engine and Airframe Icing Evaluation (Table A1A, Section 2.1.5.S.)

1. Applicability: This attachment applies to all simulators that are used to satisfy training requirements for engine and airframe ice accretion. 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 Table A1A, Section 2.1.5.S. 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, change in pitching moment, decrease in control effectiveness, decrease in stall angle of attack, 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 source. Where a particular airframe has demonstrated vulnerabilities to a specific type of ice accretion (due to accident/incident history) which may require specific training, 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 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
ii. Airspeed
iii. Normal Acceleration
iv. Engine Power/settings
v. Angle of Attack/Pitch attitude
vi. Bank Angle
vii. Flight control inputs
viii. Stall warning and stall buffet onset
ix. Other parameters as necessary to demonstrate the effects of ice accretions

b. Analysis: 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 build up) 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:

i. Decrease in stall angle of attack
ii. Increase in stall warning speed
iii. Increase in stall buffet onset speed
iv. Changes in pitching moment
v. Changes in stall buffet characteristics
vi. Changes in control effectiveness or control forces
vii. 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.

End QPS Requirements

■ 7. Part 60 is amended by revising Appendix B to read as follows:

Appendix B to Part 60—Qualification Performance Standards for Airplane Flight Training Devices

Begin Information

This appendix establishes the standards for Airplane FTD evaluation and qualification at Level 4, Level 5, Level 6, or Level 7. The Flight Standards Service, NSPM, is responsible for the development, application, and implementation of the standards contained within this appendix. The procedures and criteria specified in this appendix will be used by the NSPM, or a person or persons assigned by the NSPM when conducting airplane FTD evaluations.

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7. Additional Responsibilities of the Sponsor (§ 60.9).
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9. FTD Objective Data Requirements (§ 60.13).
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11. Initial (and Upgrade) Qualification Requirements (§ 60.15).
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18. Operations with Missing, Malfunctioning, or Inoperative Components (§ 60.25).
19. Automatic Loss of Qualification and Procedures for Restoration of Qualification (§ 60.27).
20. Other Losses of Qualification and Procedures for Restoration of Qualification (§ 60.29).
21. Record Keeping and Reporting (§ 60.31).
22. Applications, Logbooks, Reports, and Records: Fraud, Falsification, or Incorrect Statements (§ 60.33).
23. [Reserved]
24. Levels of FTD.
25. FTD Qualification on the Basis of a Bilateral Aviation Safety Agreement (BASA) (§ 60.37).
Attachment 1 to Appendix B to Part 60—General FTD Requirements.
Attachment 2 to Appendix B to Part 60—Flight Training Device (FTD) Objective Tests.
Attachment 3 to Appendix B to Part 60—Flight Training Device (FTD) Subjective Evaluation.
Attachment 4 to Appendix B to Part 60—Sample Documents.

End Information

1. Introduction

Begin Information

a. This appendix contains background information as well as regulatory and informative material as described later in this section. To assist the reader in determining what areas are required and what areas are permissive, the text in this appendix is divided into two sections: ''QPS Requirements'' and ''Information.'' The QPS Requirements sections contain details regarding compliance with the part 60 rule language. These details are regulatory, but are found only in this appendix. The Information sections contain material that is advisory in nature, and designed to give the user general information about the regulation.

b. Questions regarding the contents of this publication should be sent to the U.S. Department of Transportation, Federal Aviation Administration, Flight Standards Service, National Simulator Program Staff, AFS–205, 100 Hartsfield Centre Parkway, Suite 400, Atlanta, Georgia, 30354. Telephone contact numbers for the NSP are: phone, 404–832–4700; fax, 404–761–8906. The general email address for the NSP office is: *9-aso-avs-sim-team@faa.gov*. The NSP Internet Web site address is: *http://www.faa.gov/about/initiatives/nsp/*. On this Web site you will find an NSP personnel list with telephone and email contact information for each NSP staff member, a list of qualified flight simulation devices, ACs, a description of the qualification process, NSP policy, and an NSP ''In-Works'' section. Also linked from this site are additional information sources, handbook bulletins, frequently asked questions, a listing and text of the Federal Aviation Regulations, Flight Standards Inspector's handbooks, and other FAA links.

c. The NSPM encourages the use of electronic media for all communication, including any record, report, request, test, or statement required by this appendix. The electronic media used must have adequate security provisions and be acceptable to the NSPM. The NSPM recommends inquiries on system compatibility, and minimum system requirements are also included on the NSP Web site.

d. Related Reading References.

(1) 14 CFR part 60.

(2) 14 CFR part 61.

(3) 14 CFR part 63.

(4) 14 CFR part 119.

(5) 14 CFR part 121.

(6) 14 CFR part 125.

(7) 14 CFR part 135.

(8) 14 CFR part 141.

(9) 14 CFR part 142.

(10) AC 120–28, as amended, Criteria for Approval of Category III Landing Weather Minima.

(11) AC 120–29, as amended, Criteria for Approving Category I and Category II Landing Minima for part 121 operators.

(12) AC 120–35, as amended, Line Operational Simulations: Line-Oriented Flight Training, Special Purpose Operational Training, Line Operational Evaluation.

(13) AC 120–41, as amended, Criteria for Operational Approval of Airborne Wind Shear Alerting and Flight Guidance Systems.

(14) AC 120–45, as amended, Airplane Flight Training Device Qualification.

(14) AC 120–57, as amended, Surface Movement Guidance and Control System (SMGCS).

(15) AC 150/5300–13, as amended, Airport Design.

(16) AC 150/5340–1, as amended, Standards for Airport Markings.

(17) AC 150/5340–4, as amended, Installation Details for Runway Centerline Touchdown Zone Lighting Systems.

(18) AC 150/5340–19, as amended, Taxiway Centerline Lighting System.

(19) AC 150/5340–24, as amended, Runway and Taxiway Edge Lighting System.

(20) AC 150/5345–28, as amended, Precision Approach Path Indicator (PAPI) Systems.

(21) International Air Transport Association document, ''Flight Simulator Design and Performance Data Requirements,'' as amended.

(22) AC 25–7, as amended, Flight Test Guide for Certification of Transport Category Airplanes.

(23) AC 23–8A, as amended, Flight Test Guide for Certification of Part 23 Airplanes.

(24) International Civil Aviation Organization (ICAO) Manual of Criteria for the Qualification of Flight Simulators, as amended.

(25) Airplane Flight Simulator Evaluation Handbook, Volume I, as amended and Volume II, as amended, The Royal Aeronautical Society, London, UK.

(26) FAA Publication FAA–S–8081 series (Practical Test Standards for Airline Transport Pilot Certificate, Type Ratings, Commercial Pilot, and Instrument Ratings).

(27) The FAA Aeronautical Information Manual (AIM). An electronic version of the AIM is on the internet at *http://www.faa.gov/atpubs*.

(28) Aeronautical Radio, Inc. (ARINC) document number 436, titled *Guidelines For Electronic Qualification Test Guide* (as amended).

(29) Aeronautical Radio, Inc. (ARINC) document 610, *Guidance for Design and Integration of Aircraft Avionics Equipment in Simulators* (as amended).

End Information

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2. Applicability (§§ 60.1 and 60.2)

Begin Information

No additional regulatory or informational material applies to § 60.1, Applicability, or to § 60.2, Applicability of sponsor rules to persons who are not sponsors and who are engaged in certain unauthorized activities.

3. Definitions (§ 60.3)

See Appendix F of this part for a list of definitions and abbreviations from part 1, part 60, and the QPS appendices of part 60.

4. Qualification Performance Standards (§ 60.4)

No additional regulatory or informational material applies to § 60.4, Qualification Performance Standards.

5. Quality Management System (§ 60.5)

Additional regulatory material and informational material regarding Quality Management Systems for FTDs may be found in Appendix E of this part.

End Information

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6. Sponsor Qualification Requirements. (§ 60.7)

Begin Information

a. The intent of the language in § 60.7(b) is to have a specific FTD, identified by the sponsor, used at least once in an FAA-approved flight training program for the airplane simulated during the 12-month period described. The identification of the specific FTD may change from one 12-month period to the next 12-month period as long as that sponsor sponsors and uses at least one FTD at least once during the prescribed period. There is no minimum number of hours or minimum FTD periods required.

b. The following examples describe acceptable operational practices:

(1) Example One.

(a) A sponsor is sponsoring a single, specific FTD for its own use, in its own facility or elsewhere—this single FTD forms the basis for the sponsorship. The sponsor uses that FTD at least once in each 12-month period in that sponsor's FAA-approved flight training program for the airplane simulated. This 12-month period is established according to the following schedule:

(i) If the FTD was qualified prior to May 30, 2008, the 12-month period begins on the date of the first continuing qualification evaluation conducted in accordance with § 60.19 after May 30, 2008, and continues for each subsequent 12-month period;

(ii) A device qualified on or after May 30, 2008, will be required to undergo an initial or upgrade evaluation in accordance with § 60.15. Once the initial or upgrade evaluation is complete, the first continuing qualification evaluation will be conducted within 6 months. The 12 month continuing qualification evaluation cycle begins on that date and continues for each subsequent 12-month period.

(b) There is no minimum number of hours of FTD use required.

(c) The identification of the specific FTD may change from one 12-month period to the next 12-month period as long as that sponsor sponsors and uses at least one FTD at least once during the prescribed period.

(2) Example Two.

(a) A sponsor sponsors an additional number of FTDs, in its facility or elsewhere. Each additionally sponsored FTD must be—

(i) Used by the sponsor in the sponsor's FAA-approved flight training program for the airplane simulated (as described in § 60.7(d)(1));

OR

(ii) Used by another FAA certificate holder in that other certificate holder's FAA-approved flight training program for the airplane simulated (as described in § 60.7(d)(1)). This 12-month period is established in the same manner as in example one.

OR

(iii) Provided a statement each year from a qualified pilot, (after having flown the airplane, not the subject FTD or another FTD, during the preceding 12-month period) stating that the subject FTD's performance and handling qualities represent the airplane (as described in § 60.7(d)(2)). This statement is provided at least once in each 12-month period established in the same manner as in example one.

(b) There is no minimum number of hours of FTD use required.

(3) Example Three.

(a) A sponsor in New York (in this example, a Part 142 certificate holder) establishes ''satellite'' training centers in Chicago and Moscow.

(b) The satellite function means that the Chicago and Moscow centers must operate under the New York center's certificate (in accordance with all of the New York center's practices, procedures, and policies; e.g., instructor and/or technician training/checking requirements, record keeping, QMS program).

(c) All of the FTDs in the Chicago and Moscow centers could be dry-leased (i.e., the certificate holder does not have and use FAA-approved flight training programs for the FTDs in the Chicago and Moscow centers) because—

(i) Each FTD in the Chicago center and each FTD in the Moscow center is used at least once each 12-month period by another FAA certificate holder in that other certificate holder's FAA-approved flight training program for the airplane (as described in § 60.7(d)(1));

OR

(ii) A statement is obtained from a qualified pilot (having flown the airplane, not the subject FTD or another FTD during the preceding 12-month period) stating that the performance and handling qualities of each FTD in the Chicago and Moscow centers represents the airplane (as described in § 60.7(d)(2)).

End Information

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7. Additional Responsibilities of the Sponsor (§ 60.9)

Begin Information

The phrase ''as soon as practicable'' in § 60.9(a) means without unnecessarily disrupting or delaying beyond a reasonable time the training, evaluation, or experience being conducted in the FTD.

8. FTD Use (§ 60.11)

No additional regulatory or informational material applies to § 60.11, FTD use.

End Information

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9. FTD Objective Data Requirements (§ 60.13)

Begin QPS Requirements

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

(1) A flight test plan consisting of:

(a) The maneuvers and procedures required for aircraft certification and simulation programming and validation.

(b) 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 airplane configuration, including weight and center of gravity.

(v) The data to be gathered.

(vi) All other information necessary to recreate the flight test conditions in the FTD.

(2) Appropriately qualified flight test personnel.

(3) An understanding of the accuracy of the data to be gathered using appropriate alternative data sources, procedures, and instrumentation that is traceable to a recognized standard as described in Attachment 2, Table B2F of this appendix.

(4) Appropriate and sufficient data acquisition equipment or system(s), including appropriate data reduction and analysis methods and techniques, acceptable to the FAA's Aircraft Certification Service.

b. The data, regardless of source, must be presented:

(1) In a format that supports the FTD 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 Attachment 2, Table B2A, Appendix B;

(4) With any necessary guidance information provided; 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 in support of the validation data. The report must contain sufficient data and rationale to support qualification of the FTD at the level requested.

d. As required by § 60.13(f), the sponsor must notify the NSPM when it becomes aware that an addition to or a revision of the flight related data or airplane systems related data is available if this data is used to program and operate a qualified FTD. The data referred to in this sub-section are those data that are used to validate the performance, handling qualities, or other characteristics of the aircraft, including data related to any relevant changes occurring after the type certification is issued. The sponsor must—

(1) Within 10 calendar days, notify the NSPM of the existence of this data; and

(2) Within 45 calendar days, notify the NSPM of—

(i) The schedule to incorporate this data into the FTD; or

(ii) The reason for not incorporating this data into the FTD.

e. In those cases where the objective test results authorize a ''snapshot test'' or a ''series of snapshot test results'' in lieu of a time-history result, the sponsor or other data provider must ensure that a steady state condition exists at the instant of time captured by the ''snapshot.'' The steady state condition must exist from 4 seconds prior to, through 1 second following, the instant of time captured by the snap shot.

End QPS Requirements

Begin Information

f. The FTD sponsor is encouraged to maintain a liaison with the manufacturer of the aircraft being simulated (or with the holder of the aircraft type certificate for the aircraft being simulated if the manufacturer is no longer in business), and if appropriate, with the person having supplied the aircraft data package for the FTD in order to facilitate the notification described in this paragraph.

g. It is the intent of the NSPM that for new aircraft entering service, at a point well in advance of preparation of the QTG, the sponsor should submit to the NSPM for approval, a descriptive document (see Appendix A, Table A2C, Sample Validation Data Roadmap for Airplanes) containing the plan for acquiring the validation data, including data sources. This document 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. Additionally, this document should 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.

h. There is no requirement for any flight test data supplier to submit a flight test plan or program prior to gathering flight test data. However, the NSPM notes that inexperienced data gatherers often provide data that is irrelevant, improperly marked, or lacking adequate justification for selection. Other problems include inadequate information regarding initial conditions or test maneuvers. The NSPM has been forced to refuse these data submissions as validation data for an FTD evaluation. It is for this reason that the NSPM recommends that any data supplier not previously experienced in this area review the data necessary for programming and for validating the performance of the FTD and discuss the flight test plan anticipated for acquiring such data with the NSPM well in advance of commencing the flight tests.

i. The NSPM will consider, on a case-by-case basis, whether to approve supplemental validation data derived from flight data recording systems such as a Quick Access Recorder or Flight Data Recorder.

End Information

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10. Special Equipment and Personnel Requirements for Qualification of the FTD (§ 60.14)

Begin Information

a. In the event that the NSPM determines that special equipment or specifically qualified persons will be required to conduct an evaluation, the NSPM will make every attempt to notify the sponsor at least one (1) week, but in no case less than 72 hours, in advance of the evaluation. Examples of special equipment include flight control measurement devices, accelerometers, or oscilloscopes. Examples of specially qualified personnel include individuals

specifically qualified to install or use any special equipment when its use is required.

b. Examples of a special evaluation include an evaluation conducted after: An FTD is moved; at the request of the TPAA; or as a result of comments received from users of the FTD that raise questions about the continued qualification or use of the FTD.

End Information

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11. Initial (and Upgrade) Qualification Requirements (§ 60.15)

Begin QPS Requirement

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

(1) Meet the general requirements listed in Attachment 1 of this appendix;

(2) Meet the objective testing requirements listed in Attachment 2 of this appendix (Level 4 FTDs do not require objective tests); and

(3) Satisfactorily accomplish the subjective tests listed in Attachment 3 of this appendix.

b. The request described in § 60.15(a) must include all of the following:

(1) A statement that the FTD meets all of the applicable provisions of this part and all applicable provisions of the QPS.

(2) A confirmation that the sponsor will forward to the NSPM the statement described in § 60.15(b) in such time as to be received no later than 5 business days prior to the scheduled evaluation and may be forwarded to the NSPM via traditional or electronic means.

(3) Except for a Level 4 FTD, a QTG, acceptable to the NSPM, that includes all of the following:

(a) Objective data obtained from aircraft testing or another approved source.

(b) Correlating objective test results obtained from the performance of the FTD as prescribed in the appropriate QPS.

(c) The result of FTD subjective tests prescribed in the appropriate QPS.

(d) A description of the equipment necessary to perform the evaluation for initial qualification and the continuing qualification evaluations.

c. The QTG described in paragraph a(3) of this section, must provide the documented proof of compliance with the FTD objective tests in Attachment 2, Table B2A of this appendix.

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

(1) Parameters, tolerances, and flight conditions;

(2) Pertinent and complete instructions for conducting automatic and manual tests;

(3) A means of comparing the FTD test results to the objective data;

(4) Any other information as necessary to assist in the evaluation of the test results;

(5) Other information appropriate to the qualification level of the FTD.

e. The QTG described in paragraphs (a)(3) and (b) of this section, must include the following:

(1) A QTG cover page with sponsor and FAA approval signature blocks (see Attachment 4, Figure B4C, of this appendix, for a sample QTG cover page).

(2) A continuing qualification evaluation requirements page. This page will be used by the NSPM to establish and record the frequency with which continuing qualification evaluations must be conducted and any subsequent changes that may be determined by the NSPM in accordance with § 60.19. See Attachment 4, Figure B4G, of this appendix, for a sample Continuing Qualification Evaluation Requirements page.

(3) An FTD information page that provides the information listed in this paragraph, if applicable (see Attachment 4, Figure B4B, of this appendix, for a sample FTD information page). For convertible FTDs, the sponsor must submit a separate page for each configuration of the FTD.

(a) The sponsor's FTD identification number or code.

(b) The airplane model and series being simulated.

(c) The aerodynamic data revision number or reference.

(d) The source of the basic aerodynamic model and the aerodynamic coefficient data used to modify the basic model.

(e) The engine model(s) and its data revision number or reference.

(f) The flight control data revision number or reference.

(g) The flight management system identification and revision level.

(h) The FTD model and manufacturer.

(i) The date of FTD manufacture.

(j) The FTD computer identification.

(k) The visual system model and manufacturer, including display type.

(l) The motion system type and manufacturer, including degrees of freedom.

(4) A Table of Contents.

(5) A log of revisions and a list of effective pages.

(6) List of all relevant data references.

(7) A glossary of terms and symbols used (including sign conventions and units).

(8) Statements of compliance and capability (SOCs) with certain requirements.

(9) Recording procedures or equipment required to accomplish the objective tests.

(10) The following information for each objective test designated in Attachment 2 of this appendix, as applicable to the qualification level sought:

(a) Name of the test.

(b) Objective of the test.

(c) Initial conditions.

(d) Manual test procedures.

(e) Automatic test procedures (if applicable).

(f) Method for evaluating FTD objective test results.

(g) List of all relevant parameters driven or constrained during the automatic test(s).

(h) List of all relevant parameters driven or constrained during the manual test(s).

(i) Tolerances for relevant parameters.

(j) Source of Validation Data (document and page number).

(k) 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).

(l) FTD 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.

f. A convertible FTD is addressed as a separate FTD for each model and series airplane to which it will be converted and for the FAA qualification level sought. The NSPM will conduct an evaluation for each configuration. If a sponsor seeks qualification for two or more models of an airplane type using a convertible FTD, the sponsor must provide a QTG for each airplane model, or a QTG for the first airplane model and a supplement to that QTG for each additional airplane model. The NSPM will conduct evaluations for each airplane model.

g. The form and manner of presentation of objective test results in the QTG must include the following:

(1) The sponsor's FTD test results must be recorded in a manner acceptable to the NSPM, 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).

(2) FTD results must be labeled using terminology common to airplane parameters as opposed to computer software identifications.

(3) 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.

(4) Scaling on graphical presentations must provide the resolution necessary to evaluate the parameters shown in Attachment 2, Table B2A of this appendix.

(5) 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 FTD and airplane with respect to time. Time histories recorded via a line printer are to be clearly identified for cross-plotting on the airplane data. Over-plots may not obscure the reference data.

h. The sponsor may elect to complete the QTG objective and subjective tests at the manufacturer's facility or at the sponsor's training facility. 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 NSPM.

i. The sponsor must maintain a copy of the MQTG at the FTD location.

j. All FTDs for which the initial qualification is conducted after May 30, 2014, must have an electronic MQTG (eMQTG) including all objective data obtained from airplane testing, or another approved source (reformatted or digitized), together with correlating objective test results obtained from the performance of the FTD

(reformatted or digitized) as prescribed in this appendix. The eMQTG must also contain the general FTD performance or demonstration results (reformatted or digitized) prescribed in this appendix, and a description of the equipment necessary to perform the initial qualification evaluation and the continuing qualification evaluations. The eMQTG must include the original validation data used to validate FTD performance and handling qualities in either the original digitized format from the data supplier or an electronic scan of the original time-history plots that were provided by the data supplier. A copy of the eMQTG must be provided to the NSPM.

k. All other FTDs (not covered in subparagraph ''j'') must have an electronic copy of the MQTG by and after May 30, 2014. An electronic copy of the copy of the MQTG must be provided to the NSPM. This may be provided by an electronic scan presented in a Portable Document File (PDF), or similar format acceptable to the NSPM.

l. During the initial (or upgrade) qualification evaluation conducted by the NSPM, the sponsor must also provide a person knowledgeable about the operation of the aircraft and the operation of the FTD.

End QPS Requirements

Begin Information

m. Only those FTDs that are sponsored by a certificate holder as defined in Appendix F will be evaluated by the NSPM. However, other FTD evaluations may be conducted on a case-by-case basis as the Administrator deems appropriate, but only in accordance with applicable agreements.

n. The NSPM will conduct an evaluation for each configuration, and each FTD must be evaluated as completely as possible. To ensure a thorough and uniform evaluation, each FTD is subjected to the general FTD requirements in Attachment 1 of this appendix, the objective tests listed in Attachment 2 of this appendix, and the subjective tests listed in Attachment 3 of this appendix. The evaluations described herein will include, but not necessarily be limited to the following:

(1) Airplane responses, including longitudinal and lateral-directional control responses (see Attachment 2 of this appendix);

(2) Performance in authorized portions of the simulated airplane's operating envelope, to include tasks evaluated by the NSPM in the areas of surface operations, takeoff, climb, cruise, descent, approach and landing, as well as abnormal and emergency operations (see Attachment 2 of this appendix);

(3) Control checks (see Attachment 1 and Attachment 2 of this appendix);

(4) Flight deck configuration (see Attachment 1 of this appendix);

(5) Pilot, flight engineer, and instructor station functions checks (see Attachment 1 and Attachment 3 of this appendix);

(6) Airplane systems and sub-systems (as appropriate) as compared to the airplane simulated (see attachment 1 and attachment 3 of this appendix);

(7) FTD systems and sub-systems, including force cueing (motion), visual, and aural (sound) systems, as appropriate (see Attachment 1 and Attachment 2 of this appendix); and

(8) 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.

o. The NSPM administers the objective and subjective tests, which include an examination of functions. The tests include a qualitative assessment of the FTD by an NSP pilot. The NSP 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.

(1) Objective tests provide a basis for measuring and evaluating FTD performance and determining compliance with the requirements of this part.

(2) Subjective tests provide a basis for:

(a) Evaluating the capability of the FTD to perform over a typical utilization period;

(b) Determining that the FTD satisfactorily simulates each required task;

(c) Verifying correct operation of the FTD controls, instruments, and systems; and

(d) Demonstrating compliance with the requirements of this part.

p. The tolerances for the test parameters listed in Attachment 2 of this appendix reflect the range of tolerances acceptable to the NSPM 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 NSPM 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 way the data was gathered and applied) data presentations, and the applicable tolerances for each test.

q. In addition to the scheduled continuing qualification evaluation, each FTD is subject to evaluations conducted by the NSPM 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 flight crewmember training, testing, or checking. However, if the FTD were being used, the evaluation would be conducted in a nonexclusive manner. This nonexclusive evaluation will be conducted by the FTD evaluator accompanying the check airman, instructor, Aircrew Program Designee (APD), or FAA inspector aboard the FTD along with the student(s) and observing the operation of the FTD during the training, testing, or checking activities.

r. Problems with objective test results are handled as follows:

(1) If a problem with an objective test result is detected by the NSP evaluation team during an evaluation, the test may be repeated or the QTG may be amended.

(2) If it is determined that the results of an objective test do not support the qualification level requested but do support a lower level, the NSPM may qualify the FTD at a lower level. For example, if a Level 6 evaluation is requested, but the FTD fails to meet the spiral stability test tolerances, it could be qualified at Level 5.

s. After an FTD is successfully evaluated, the NSPM issues an SOQ to the sponsor. The NSPM recommends the FTD to the TPAA, who will approve the FTD for use in a flight training program. The SOQ 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 Table B1B in attachment 1 of this appendix. However, it is the sponsor's responsibility to obtain TPAA approval prior to using the FTD in an FAA-approved flight training program.

t. Under normal circumstances, the NSPM establishes a date for the initial or upgrade evaluation within ten (10) working days after determining that a complete QTG is acceptable. Unusual circumstances may warrant establishing an evaluation date before this determination is made. A sponsor may schedule an evaluation date as early as 6 months in advance. However, there may be a delay of 45 days or more in rescheduling and completing the evaluation if the sponsor is unable to meet the scheduled date. See Attachment 4, Figure B4A, Sample Request for Initial, Upgrade, or Reinstatement Evaluation, of this appendix.

u. The numbering system used for objective test results in the QTG should closely follow the numbering system set out in Attachment 2, FTD Objective Tests, Table B2A, of this appendix.

v. Contact the NSPM or visit the NSPM Web site for additional information regarding the preferred qualifications of pilots used to meet the requirements of § 60.15(d).

w. Examples of the exclusions for which the FTD might not have been subjectively tested by the sponsor or the NSPM and for which qualification might not be sought or granted, as described in § 60.15(g)(6), include engine out maneuvers or circling approaches.

12. Additional Qualifications for Currently Qualified FTDs (§ 60.16)

No additional regulatory or informational material applies to § 60.16, Additional Qualifications for a Currently Qualified FTD.

End Information

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13. Previously Qualified FTDs (§ 60.17)

Begin QPS Requirements

a. In instances where a sponsor plans to remove an FTD from active status for a period of less than two years, the following procedures apply:

(1) The NSPM must be notified in writing and the notification must include an estimate of the period that the FTD will be inactive;

(2) Continuing Qualification evaluations will not be scheduled during the inactive period;

(3) The NSPM will remove the FTD from the list of qualified FTDs on a mutually established date not later than the date on which the first missed continuing

qualification evaluation would have been scheduled;

(4) Before the FTD is restored to qualified status, it must be evaluated by the NSPM. 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.

(5) The sponsor must notify the NSPM of any changes to the original scheduled time out of service;

b. FTDs qualified prior to May 30, 2008, and replacement FTD systems, are not required to meet the general FTD requirements, the objective test requirements, and the subjective test requirements of Attachments 1, 2, and 3 of this appendix as long as the FTD continues to meet the test requirements contained in the MQTG developed under the original qualification basis.

c. [Reserved]

d. FTDs qualified prior to May 30, 2008, may be updated. If an evaluation is deemed appropriate or necessary by the NSPM after such an update, the evaluation will not require an evaluation to standards beyond those against which the FTD was originally qualified.

End QPS Requirements

Begin Information

e. Other certificate holders or persons desiring to use an FTD may contract with FTD sponsors to use FTDs previously qualified at a particular level for an airplane type and approved for use within an FAA-approved flight training program. Such FTDs are not required to undergo an additional qualification process, except as described in § 60.16.

f. Each FTD user must obtain approval from the appropriate TPAA to use any FTD in an FAA-approved flight training program.

g. The intent of the requirement listed in § 60.17(b), for each FTD to have an SOQ within 6 years, is to have the availability of that statement (including the configuration list and the limitations to authorizations) to provide a complete picture of the FTD inventory regulated by the FAA. The issuance of the statement will not require any additional evaluation or require any adjustment to the evaluation basis for the FTD.

h. Downgrading of an FTD is a permanent change in qualification level and will necessitate the issuance of a revised SOQ to reflect the revised qualification level, as appropriate. If a temporary restriction is placed on an FTD because of a missing, malfunctioning, or inoperative component or on-going repairs, the restriction is not a permanent change in qualification level. Instead, the restriction is temporary and is removed when the reason for the restriction has been resolved.

i. The NSPM will determine the evaluation criteria for an FTD that has been removed from active status for a prolonged period. The criteria will be based on the number of continuing qualification evaluations and quarterly inspections missed during the period of inactivity. For example, if the FTD were out of service for a 1 year period, it would be necessary to complete the entire QTG, since all of the quarterly evaluations would have been missed. The NSPM will also consider how the FTD was stored, whether parts were removed from the FTD and whether the FTD was disassembled.

j. The FTD will normally be requalified using the FAA-approved MQTG and the criteria that was in effect prior to its removal from qualification. However, inactive periods of 2 years or more will require re-qualification under the standards in effect and current at the time of requalification.

End Information

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14. Inspection, Continuing Qualification, Evaluation, and Maintenance Requirements (§ 60.19).

Begin QPS Requirement

a. The sponsor must conduct a minimum of four evenly spaced inspections throughout the year. The objective test sequence and content of each inspection in this sequence must be developed by the sponsor and must be acceptable to the NSPM.

b. The description of the functional preflight check must be contained in the sponsor's QMS.

c. Record ''functional preflight'' in the FTD discrepancy log book or other acceptable location, including any item found to be missing, malfunctioning, or inoperative.

d. During the continuing qualification evaluation conducted by the NSPM, the sponsor must also provide a person knowledgeable about the operation of the aircraft and the operation of the FTD.

End QPS Requirements

Begin Information

e. The sponsor's test sequence and the content of each quarterly inspection required in § 60.19(a)(1) should include a balance and a mix from the objective test requirement areas listed as follows:

(1) Performance.

(2) Handling qualities.

(3) Motion system (where appropriate).

(4) Visual system (where appropriate).

(5) Sound system (where appropriate).

(6) Other FTD systems.

f. If the NSP 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 sweeps, or motion or visual system tests.

g. The continuing qualification evaluations described in § 60.19(b) 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:

(1) Review of the results of the quarterly inspections conducted by the sponsor since the last scheduled continuing qualification evaluation.

(2) A selection of approximately 8 to 15 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 (⅓) of the allotted FTD time.

(3) A subjective evaluation of the FTD to perform a representative sampling of the tasks set out in attachment 3 of this appendix. This portion of the evaluation should take approximately two-thirds (⅔) of the allotted FTD time.

(4) An examination of the functions of the FTD may include the motion system, visual system, sound system as applicable, instructor operating station, and the normal functions and simulated malfunctions of the airplane systems. This examination is normally accomplished simultaneously with the subjective evaluation requirements.

h. The requirement established in § 60.19(b)(4) regarding the frequency of NSPM-conducted continuing qualification evaluations for each FTD is typically 12 months. However, the establishment and satisfactory implementation of an approved QMS for a sponsor will provide a basis for adjusting the frequency of evaluations to exceed 12-month intervals.

15. Logging FTD Discrepancies (§ 60.20)

No additional regulatory or informational material applies to § 60.20. Logging FTD Discrepancies.

16. Interim Qualification of FTDs for New Airplane Types or Models (§ 60.21)

No additional regulatory or informational material applies to § 60.21, Interim Qualification of FTDs for New Airplane Types or Models.

End Information

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17. Modifications to FTDs (§ 60.23)

Begin QPS Requirements

a. The notification described in § 60.23(c)(2) must include a complete description of the planned modification, with a description of the operational and engineering effect the proposed modification will have on the operation of the FTD and the results that are expected with the modification incorporated.

b. Prior to using the modified FTD:

(1) All the applicable objective tests completed with the modification incorporated, including any necessary updates to the MQTG (e.g., accomplishment of FSTD Directives) must be acceptable to the NSPM; and

(2) The sponsor must provide the NSPM with a statement signed by the MR that the factors listed in § 60.15(b) are addressed by the appropriate personnel as described in that section.

End QPS Requirements

Begin Information

c. FSTD Directives are considered modification of an FTD. See Attachment 4 of this appendix for a sample index of effective FSTD Directives.

d. Examples of MQTG changes that do not require notification under § 60.23(a) are limited to repagination, correction of typographical or grammatical errors, typesetting, or presenting additional parameters on existing test result formats. All changes regardless of nature should be reported in the MQTG revision history.

End Information

18. Operation With Missing, Malfunctioning, or Inoperative Components (§ 60.25)

Begin Information

a. The sponsor's responsibility with respect to § 60.25(a) is satisfied when the sponsor fairly and accurately advises the user of the current status of an FTD, including any missing, malfunctioning, or inoperative (MMI) component(s).

b. It is the responsibility of the instructor, check airman, or representative of the administrator conducting training, testing, or checking to exercise reasonable and prudent judgment to determine if any MMI component is necessary for the satisfactory completion of a specific maneuver, procedure, or task.

c. If the 29th or 30th day of the 30-day period described in § 60.25(b) is on a Saturday, a Sunday, or a holiday, the FAA will extend the deadline until the next business day.

d. In accordance with the authorization described in § 60.25(b), the sponsor may develop a discrepancy prioritizing system to accomplish repairs based on the level of impact on the capability of the FTD. Repairs having a larger impact on the FTD's ability to provide the required training, evaluation, or flight experience will have a higher priority for repair or replacement.

End Information

19. Automatic Loss of Qualification and Procedures for Restoration of Qualification (§ 60.27)

Begin Information

If the sponsor provides a plan for how the FTD will be maintained during its out-of-service period (e.g., periodic exercise of mechanical, hydraulic, and electrical systems; routine replacement of hydraulic fluid; control of the environmental factors in which the FTD is to be maintained) there is a greater likelihood that the NSPM will be able to determine the amount of testing that required for requalification.

End Information

20. Other Losses of Qualification and Procedures for Restoration of Qualification (§ 60.29.)

Begin Information

If the sponsor provides a plan for how the FTD will be maintained during its out-of-service period (e.g., periodic exercise of mechanical, hydraulic, and electrical systems; routine replacement of hydraulic fluid; control of the environmental factors in which the FTD is to be maintained) there is a greater likelihood that the NSPM will be able to determine the amount of testing that required for requalification.

End Information

21. Recordkeeping and Reporting (§ 60.31.)

Begin QPS Requirements

a. FTD modifications can include hardware or software changes. For FTD modifications involving software programming changes, the record required by § 60.31(a)(2) must consist of the name of the aircraft system software, aerodynamic model, or engine model change, the date of the change, a summary of the change, and the reason for the change.

b. If a coded form for record keeping is used, it must provide for the preservation and retrieval of information with appropriate security or controls to prevent the inappropriate alteration of such records after the fact.

End QPS Requirements

22. Applications, Logbooks, Reports, and Records: Fraud, Falsification, or Incorrect Statements (§ 60.33)

Begin Information

No additional regulatory or informational material applies to § 60.33, Applications, Logbooks, Reports, and Records: Fraud, Falsification, or Incorrect Statements.

End Information

23. [Reserved]

24. Levels of FTD

Begin Information

a. The following is a general description of each level of FTD. Detailed standards and tests for the various levels of FTDs are fully defined in Attachments 1 through 3 of this appendix.

(1) Level 4. A device that may have an open airplane-specific flight deck area, or an enclosed airplane-specific flight deck and 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.

(2) Level 5. A device that may have an open airplane-specific flight deck area, or an enclosed airplane-specific flight deck; generic aerodynamic programming; at least one operating system; and control loading that is representative of the simulated airplane only at an 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, nosewheel steering, trim, brakes) must be physical controls. All other controls, switches, and knobs may be touch sensitive activation.

(3) Level 6. A device that has an enclosed airplane-specific flight deck; airplane-specific aerodynamic programming; all applicable airplane systems operating; control loading that is representative of the simulated airplane 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.

(4) Level 7. A Level 7 device is one that has an enclosed airplane-specific flight deck and aerodynamic program with all applicable airplane systems operating and control loading that is representative of the simulated airplane 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. It also has 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 200° horizontally and 40° vertically.

End Information

25. FTD Qualification on the Basis of a Bilateral Aviation Safety Agreement (BASA) (§ 60.37)

Begin Information

No additional regulatory or informational material applies to § 60.37, FTD Qualification on the Basis of a Bilateral Aviation Safety Agreement (BASA).

End Information

Attachment 1 to Appendix B to Part 60—General FTD Requirements

Begin QPS Requirements

1. Requirements

a. Certain requirements included in this appendix must be supported with an SOC as

defined in Appendix F, which may include objective and subjective tests. The requirements for SOCs are indicated in the ''General FTD Requirements'' column in Table B1A of this appendix.

b. Table B1A describes the requirements for the indicated level of FTD. Many devices include operational systems or functions that exceed the requirements outlined in this section. In any event, all systems will be tested and evaluated in accordance with this appendix to ensure proper operation.

End QPS Requirements

Begin Information

2. Discussion

a. This attachment describes the general requirements for qualifying Level 4 through Level 7 FTDs. The sponsor should also consult the objectives tests in Attachment 2 of this appendix and the examination of functions and subjective tests listed in Attachment 3 of this appendix to determine the complete requirements for a specific level FTD.

b. The material contained in this attachment is divided into the following categories:

(1) General Flight deck Configuration.

(2) Programming.

(3) Equipment Operation.

(4) Equipment and facilities for instructor/evaluator functions.

(5) Motion System.

(6) Visual System.

(7) Sound System.

c. Table B1A provides the standards for the General FTD Requirements.

d. Table B1B 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.

e. Table B1C provides the functions that an instructor/check airman must be able to control in the simulator.

f. 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.

End Information

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	**FTD Level**				**INFORMATION**
Entry Number	**General FTD Requirements**	**4**	**5**	**6**	**7**	**Notes**
1.	**FEATURE GENERAL REQUIREMENT** **FLIGHT DECK LAYOUT & STRUCTURE**					
1.S	**An enclosed full scale replica of the airplane cockpit/flight deck, which will have fully functional controls, instruments and switches to support the approved use.** **Anything not required to be accessed by the flight crew during normal, abnormal, emergency and, where applicable, non-normal operations does not need to be functional.**			**X**	**X**	
1.R	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.G	**Reserved**					
	FEATURE TECHNICAL REQUIREMENT COCKPIT/FLIGHT DECK LAYOUT & STRUCTURE					
1.1	COCKPIT/FLIGHT DECK STRUCTURE					
1.1.S.a	Reserved					
1.1.S.b	An enclosed, full scale replica of the cockpit/flight deck of the airplane being simulated except the enclosure need only extend to the aft end of the cockpit/flight deck area.			**X**	**X**	
1.1.S.c	An enclosed, full scale replica of the cockpit/flight deck of the airplane being simulated including all: structure and panels; primary and secondary flight controls; engine and propeller controls, as applicable; equipment and systems with associated controls and observable indicators; circuit breakers; flight instruments; navigation, communications and similar use equipment; caution and warning systems and emergency equipment. The tactile feel, technique, effort, travel and direction required to manipulate the preceding, as applicable, must replicate those in the airplane. As applicable, equipment for operation of the cockpit/flight deck windows must be included but the actual windows need not be operable. Additional required flight crew member duty stations and those bulkheads aft of the pilots' seats containing items such as switches, circuit breakers, supplementary radio panels, etc., to which the flight crew may require access during any event after pre-flight cockpit/flight deck preparation is complete, are also considered part of the cockpit/flight deck and must replicate the airplane. *Note.— The cockpit/flight deck, for flight simulation purposes, consists of all that space forward of a cross section of the fuselage at the most extreme aft setting of the flight crew members' seats or if applicable, to that cross section*			**X**	**X**	Airplane observer seats are not considered to be additional flight crew member duty stations and may be omitted. The use of electronically displayed images with physical overlay or masking for FSTD instruments and/or instrument panels is acceptable provided: – all instruments and instrument panel layouts are dimensionally correct with differences, if any, being imperceptible to the pilot; – instruments replicate those of the airplane including full instrument functionality and embedded logic;

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
	immediately aft of additional flight crew member seats and/or required bulkheads.					– instruments displayed are free of quantization (stepping); – instrument display characteristics replicate those of the airplane including: resolution, colors, luminance, brightness, fonts, fill patterns, line styles and symbology; – overlay or masking, including bezels and bugs, as applicable, replicates the airplane panel(s); – instrument controls and switches replicate and operate with the same technique, effort, travel and in the same direction as those in the airplane; – 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; – as applicable, instruments should have faceplates that replicate those in the airplane.
1.1.R	Reserved					
1.1.G	Reserved					
1.2	SEATING					
1.2.1.S	Flight crew member seats must replicate those in the airplane being simulated.			X	X	
1.2.1.R	Reserved					
1.2.1.G	Reserved					
1.2.2.S.a	Reserved					
1.2.2.S.b	In addition to the flight crew member seats, there must be one instructor station seat, and two suitable seats for an observer and an FAA inspector.				X	At least one seat should have a system to permit selective monitoring of all flight crew member and instructor communications.
1.2.2.R	Reserved					
1.2.2.G	Reserved					

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
1.3	COCKPIT/FLIGHT DECK LIGHTING					
1.3.S.a	Cockpit/flight deck lighting must replicate that in the airplane				X	
1.3.S.b	The lighting environment for panels and instruments must be sufficient for the operation being conducted.			X		Back-lighted panels and instruments may be installed but are not required.
1.3.R	The lighting environment for panels and instruments must be sufficient for the operation being conducted.	X	X			Back-lighted panels and instruments may be installed but are not required.
1.3.G	Reserved					
2.	**FEATURE GENERAL REQUIREMENT** **FLIGHT MODEL**					
2.S	**Aerodynamic and engine modeling for all combinations of drag and thrust, including the effects of change in airplane attitude, sideslip, altitude, temperature, gross mass, center of gravity location and configuration to support the approved use.** **Must address ground effect, mach effect, aeroelastic representations, non-linearities due to sideslip, effects of airframe icing, forward and reverse dynamic thrust effect on control surfaces.** **Realistic airplane mass properties, including mass, center of gravity and moments of inertia as a function of payload and fuel loading must be implemented.** **Extended envelope modeling to the extent necessary for full stall training and upset recovery training.**				X	
2.S1	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. An SOC is required.			X		
2.R	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 5 requires only generic aerodynamic programming. An SOC is required.		X			
2.G	**Reserved**					
	FEATURE TECHNICAL REQUIREMENT FLIGHT MODEL					
2.1	FLIGHT DYNAMICS MODEL					
2.1.1.S	Flight dynamics model that accounts for various combinations of drag and thrust normally encountered in flight supported by type-specific flight test data, including the effect of change in airplane attitude, sideslip, thrust, drag, altitude, temperature, gross mass, moments of inertia, center of gravity location and configuration to support the approved use.				X	
2.1.2.S	Aerodynamic modeling that includes, for airplanes issued an original type certificate after 30 June 1980, Mach effect, normal and reverse dynamic thrust effect on control surfaces, aeroelastic effect and representations of non-linearities due to side-slip based on airplane flight test data provided by the airplane manufacturer.				X	SOC required. Mach effect, aeroelastic representations and non-linearities due to side-slip are normally included in the flight simulator aerodynamic model. The SOC

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
						should address each of these items. Separate tests for thrust effects and an SOC are required.
2.1.3.S	Aerodynamic modeling to include ground effect derived from type-specific flight test data. For example: round-out, flare and touchdown. This requires data on lift, drag, pitching moment, trim and power in ground effect.				X	SOC required. See Attachment 2, paragraph 5 and test 2.f for further information on ground effect.
2.1.4.S	Aerodynamic modeling for the effects of reverse thrust on directional control.				X	Tests required. See Attachment 2, tests 2.e.8 and 2.e.9 (directional control).
2.1.5.S	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 airplane 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 autoflight system) must respond properly to detected ice accretion consistent with the simulated aircraft. Aircraft OEM data or other acceptable analytical methods must be utilized to develop ice accretion models that are representative of the simulated aircraft's performance degradation in a typical in-flight icing encounter. SOC and tests required. See objective testing requirements.				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 airplanes 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 Attachment 7 of Appendix A for further guidance material.
2.1.6.S	Reserved					
2.1.7.S	Reserved					
2.1.R	Reserved					
2.1.G	Reserved					
2.2	MASS PROPERTIES					
2.2.S	Type specific implementation of airplane mass properties, including mass, center of gravity and moments of inertia as a function of payload and fuel loading. The effects of pitch attitude and of fuel slosh on the aircraft center of gravity must be simulated.				X	SOC required. SOC should include a range of tabulated target values to enable a demonstration of the mass properties model to be conducted from the instructor's station. The SOC should include the effects of fuel slosh on center of gravity.
2.2.S1	Level 6 requires the effects of changes in gross weight and center of gravity. An SOC is required.			X		

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
2.2.R	Reserved					
2.2.G	Reserved					
3.	**FEATURE GENERAL REQUIREMENT GROUND REACTION AND HANDLING CHARACTERISTICS**					
3.S	**Represents ground reaction and handling characteristics of the airplane during surface operations to support the approved use. Brake and tire failure dynamics (including antiskid) and decreased brake efficiency must be specific to the aircraft simulated. Stopping and directional control forces must be representative for all environmental runway conditions.**				**X**	
3.R	**Reserved**					
3.G	**Reserved**					
	FEATURE TECHNICAL REQUIREMENT GROUND REACTION AND HANDLING CHARACTERISTICS					
3.1	GROUND REACTION AND HANDLING CHARACTERISTICS					
3.1.S	Airplane type specific ground handling simulation to include: (1) Ground reaction. Reaction of the airplane upon contact with the runway during take-off, landing and ground operations to include strut deflections, tire friction, side forces, environmental effects and other appropriate data, such as weight and speed, necessary to identify the flight condition and configuration. Ground reaction modeling must properly simulate the effects of a bounced or skipped landing (to include tail strike) as appropriate for the simulated aircraft and conditions; and (2) Ground handling characteristics. Steering inputs to include crosswind, gusting crosswind, braking, thrust reversing, deceleration and turning radius. Ground handling must react properly to crosswind and gusting crosswind up to the aircraft's maximum demonstrated crosswind component. SOC required.				**X**	Tests required.
3.1.R	Reserved					
3.1.G	Reserved					
3.2	RUNWAY CONDITIONS					
3.2.S	Stopping and directional control forces for at least the following runway conditions based on airplane related data: (1) dry; (2) wet; (3) icy; (4) patchy wet;				**X**	Objective tests required for (1), (2) and (3). See Attachment 2, tests 1.e (stopping). Subjective tests for (4), (5) and (6). See Attachment 3.

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
	(5) patchy icy; and (6) wet on rubber residue in touchdown zone. SOC required.					
3.2.R	Reserved					
3.2.G	Reserved					
3.3	BRAKE AND TIRE FAILURES					
3.3.S	Brake and tire failure dynamics (including anti-skid) and decreased braking efficiency due to brake temperatures.				X	SOC required. Subjective tests required for decreased braking efficiency due to brake temperature, if applicable.
3.3.R	Reserved					
3.3.G	Reserved					
4.	**FEATURE GENERAL REQUIREMENT AIRPLANE SYSTEMS (ATA)**					
4.S	**Airplane systems must be replicated with sufficient functionality for flight crew operation to support the approved use. System functionality must enable all normal, abnormal, and emergency operating procedures to be accomplished. To include communications, navigation, caution and warning equipment corresponding to the airplane. Circuit breakers required for operations must be functional.**				X	
4.S1,S2,R	**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.**	X	X	X		
4.G	**Reserved**					
	FEATURE TECHNICAL REQUIREMENT AIRPLANE SYSTEMS (ATA)					
4.1	NORMAL, ABNORMAL AND EMERGENCY SYSTEMS OPERATION					
4.1.S	All airplane systems represented in the FSTD must simulate the specific airplane type system operation including system interdependencies, both on the ground and in flight. Systems must be operative to the extent that all normal, abnormal and emergency operating procedures can be accomplished.				X	Airplane system operation should be predicated on, and traceable to, the system data supplied by either the airplane manufacturer, original equipment manufacturer or alternative approved data for the airplane 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.

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
4.1.S1	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		
4.1.S2	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 5 must have at least functional flight and navigational controls, displays, and instrumentation.		X			
4.1.R	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 4 must have at least one airplane system installed and functional.	X				
4.1.G	Reserved					
4.2	CIRCUIT BREAKERS					
4.2.S,S1	Circuit breakers that affect procedures and/or result in observable cockpit/flight deck indications must be functionally accurate.			X	X	
4.2.R	Reserved					
4.2.G	Reserved					
4.3	INSTRUMENT INDICATIONS					
4.3.S	All relevant instrument indications involved in the simulation of the airplane must automatically respond to control movement by a flight crew member or to atmospheric disturbance and also respond to effects resulting from icing.				X	Numerical values should be presented in the appropriate units.
4.3.S1,S2	All relevant instrument indications involved in the simulation of the airplane must automatically respond to control movement or external disturbances to the simulated airplane; e.g., turbulence or winds.		X	X		
4.3.G	N/A.					
4.4	COMMUNICATIONS, NAVIGATION AND CAUTION AND WARNING SYSTEMS					
4.4.S	Communications, navigation, and caution and warning equipment corresponding to that installed in a specific airplane type must operate within the tolerances prescribed for the applicable airborne equipment.				X	
4.4.S1	Navigation equipment must be installed and operate within the tolerances applicable for the airplane. Level 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.			X		
4.4.S2	Navigation equipment must be installed and operate within the tolerances applicable for the airplane. Level 5 need have only that navigation equipment necessary to fly an instrument approach.		X			
4.4.G	N/A.					
4.5	ANTI-ICING SYSTEMS					
4.5.S,S1	Operation of anti-icing systems corresponding to those installed in the specific airplane type must operate with appropriate effects upon ice formation on airframe, engines and instrument sensors.			X	X	

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
4.5.R	Reserved					
4.5.G	N/A.					
5.	**FEATURE GENERAL REQUIREMENT** **FLIGHT CONTROLS AND FORCES**					
5.S	**Control forces and control travel must correspond to that of the airplane to support the approved use.** **Control displacement must generate the same effect as the airplane under the same flight conditions.** **Control feel dynamics must replicate the airplane simulated.**				**X**	
5.S1	**Control forces and control travel must correspond to that of the airplane to support the approved use.** **Control displacement must generate the same effect as the airplane under the same flight conditions.**			**X**		
5.R	**Control forces and control travel must correspond to that of the airplane to support the approved use.**		**X**			
5.G	**Reserved**					
	FEATURE TECHNICAL REQUIREMENT FLIGHT CONTROLS AND FORCES					
5.1	CONTROL FORCES AND TRAVEL					Testing of position versus force is not applicable if forces are generated solely by use of airplane hardware in the FSTD.
5.1.S	Control forces, control travel and surface position must correspond to that of the type-specific airplane being replicated. Control travel, forces and surfaces must react in the same manner as in the airplane under the same flight and system conditions.				**X**	Active Force feedback required if appropriate to the airplane installation.
5.1.S1	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.			**X**		
5.1.R	The FTD must provide control forces and control travel of sufficient precision to manually fly an instrument approach.		**X**			
5.1.G	Reserved					
5.2	CONTROL FEEL DYNAMICS					
5.2.S	Control feel dynamics must replicate the airplane simulated.				**X**	See Appendix A (Attachment 2), paragraph 4 for a discussion of acceptable methods of validating control dynamics. Tests required. See Attachment 2, tests 2.b.1 through 2.b.3 (dynamic control checks).
5.2.S1,R,G	N/A.					
5.3	CONTROL SYSTEM OPERATION					
5.3.S,S1	Control systems must replicate airplane operation for the normal and any non-normal modes including back-up systems and must reflect failures of associated systems. Appropriate cockpit indications and messages must be replicated.			**X**	**X**	
5.3.R	Reserved					

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
5.3.G	Reserved					
6.	**FEATURE GENERAL REQUIREMENT SOUND CUES**					
6.S	**N/A.**					
6.R	**Significant sounds perceptible to the flight crew during flight operations to support the approved use. Comparable engine, airframe and environmental sounds. The volume control must have an indication of sound level setting.**				**X**	Objective tests required
6.R1	The FTD must simulate significant flight deck sounds resulting from pilot actions that correspond to those heard in the airplane.			**X**		
	FEATURE TECHNICAL REQUIREMENT SOUND CUES					
6.1	SOUND SYSTEM					
6.1.R	Significant cockpit/flight deck sounds during normal and abnormal operations corresponding to those of the airplane, including engine and airframe sounds as well as those which result from pilot or instructor-induced actions. SOC required. Tests required.				**X**	See Attachment 2.
6.1.R1	Significant cockpit/flight deck sounds during normal and abnormal operations corresponding to those of the airplane, including engine and airframe sounds as well as those which result from pilot or instructor-induced actions.			**X**		
6.1.G	Reserved					
6.2	CRASH SOUNDS					
6.2.R	The sound of a crash when the simulated airplane exceeds limitations.				**X**	
6.2.G	Reserved					
6.3	ENVIRONMENTAL SOUNDS					
6.3.R	Significant environmental sounds must be coordinated with the simulated weather.				**X**	
6.3.G	Reserved					
6.4	SOUND VOLUME					
6.4.R	The volume control must have an indication of sound level setting which meets all qualification requirements. Full volume must correspond to actual volume levels in the approved data set. When full volume is not selected, an indication of abnormal setting must be provided to the instructor.				**X**	The abnormal setting should consist of an annunciation on a main IOS page which is always visible to the instructor.
6.4.G	Reserved					
6.5	SOUND DIRECTIONALITY					
6.5.R,	Sound must be directionally representative. SOC required.				**X**	

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
6.5.G	Reserved					
7.	**FEATURE GENERAL REQUIREMENT** **VISUAL DISPLAY CUE**					
7.S	**Reserved**					
7.R	**Continuous field of view with textured representation of all ambient conditions for each pilot, to support the approved use.** **Horizontal and vertical field of view to support the most demanding maneuvers requiring a continuous view of the runway.** **A minimum of 200° horizontal and 40° vertical field of view.**				**X**	
7.R1	**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 (R1):**	**X**	**X**	**X**		
7.R1	**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.
7.G	**Reserved**					
	FEATURE TECHNICAL REQUIREMENT VISUAL CUES					
7.1	DISPLAY					
7.1.1	DISPLAY GEOMETRY AND FIELD OF VIEW					
7.1.1.S	Reserved					
7.1.1.R	Continuous visual field of view providing each pilot with 200° horizontal and 40° vertical 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 eyepoints).				**X**	See Attachment 2 – Test 4.a.1. The system should have the capability to align the view to the pilot flying. Installed alignment should be confirmed in an SOC. (This would generally be results from acceptance testing).
7.1.1.R1	The visual system must provide at least a field-of-view of 18° vertical / 24° horizontal for the pilot flying. 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 instrument panel and provide for a maximum parallax error of 10 degrees per pilot. An SOC is required	**X**	**X**	**X**		
7.1.1.G	Reserved					

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
7.1.2	DISPLAY RESOLUTION					
7.1.2.S	Reserved					
7.1.2.R	Display resolution demonstrated by a test pattern of objects shown to occupy a visual angle of not greater than 4 arc minutes in the visual display used on a scene from the pilot's eye point. SOC required containing calculations confirming resolution.				X	See Attachment 2 (visual scene quality) – Test 4.a.3.
7.1.2.R1	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		
7.1.2.G	Reserved					
7.1.3	LIGHT-POINT SIZE					
7.1.3.S	Reserved					
7.1.3.R	Light-point size — not greater than 8 arc minutes. SOC required confirming test pattern represents lights used for airport lighting.				X	See Attachment 2 – Test 4.a.4.
7.1.3.G	Reserved					
7.1.4	DISPLAY CONTRAST RATIO					
7.1.4.S	Reserved					
7.1.4.R	Display Contrast ratio — not less than 5:1.				X	See Attachment 2 (surface contrast ratio) – Test 4.a.5.
7.1.4.G	Reserved					
7.1.5	LIGHT-POINT CONTRAST RATIO					
7.1.5.S	Reserved					
7.1.5.R	Light-point contrast ratio — not less than 10:1.				X	See Attachment 2 (light-point contrast ratio) – Test 4.a.6.
7.1.5.G	Reserved					
7.1.6	LIGHT-POINT BRIGHTNESS					
7.1.6.S	Reserved					
7.1.6.R	Light-point brightness – not less than 20 cd/m^2 (5.8 foot-lamberts).				X	See Attachment 2 (light-point brightness) – Test 4.a.7.
7.1.6.G	Reserved					
7.1.7	DISPLAY BRIGHTNESS					
7.1.7.S	Reserved					
7.1.7.R	Display brightness must be demonstrated using a raster drawn test pattern. The surface brightness must not be less than 14 cd/m^2 (4.1 foot-lamberts).				X	See Appendix B – Test 4.a.8.
7.1.7.G	Reserved					
7.1.8	BLACK LEVEL AND SEQUENTIAL CONTRAST (**Light valve systems only**)					

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
7.1.8.S	Reserved					
7.1.8.R	Suitable to support the approved use.				X	
7.1.8.G	Reserved					
7.1.9	MOTION BLUR (**Light valve systems only**)					
7.1.9.S	Reserved					
7.1.9.R	Suitable to support the approved use.				X	
7.1.9.G	Reserved					
7.1.10	SPECKLE TEST (**Laser systems only**)					
7.1.10.S	Reserved					
7.1.10.R	Suitable to support the approved use.				X	
7.1.10.G	Reserved					
7.2	ADDITIONAL DISPLAY SYSTEMS					
7.2.1	HEAD-UP DISPLAY (where fitted)					
7.2.1.S	Reserved					
7.2.1.R	The system must be shown to perform its intended function for each operation and phase of flight. An active display (repeater) of all parameters displayed on the pilot's combiner must be located on the instructor operating station (IOS), or other location approved by the NSPM. Display format of the repeater must represent that of the combiner. SOC required.				X	See Attachment 2 – Test 4.b Only the one HUD can be used by the pilot flying due to alignment display issues. Alternatively the HUD may be presented as part of the visual scene.
7.2.1.G	N/A.					
7.2.2	ENHANCED FLIGHT VISION SYSTEM (EFVS) (Where fitted)					
7.2.2.S	Reserved					
7.2.2.R	The EFVS simulator hardware/software, including associated cockpit displays and annunciation, must function the same or equivalent to the EFVS system installed in the airplane. A minimum of one airport must be modeled for EFVS operation. The model must include an ILS and a non-precision approach (with VNAV if required for that airplane type).				X	See Attachment 2 – Test 4.c Only the one EFVS can be used by the pilot flying due to alignment display issues. Alternatively the EFVS may be presented as part of the visual scene.
7.2.2.G	N/A.					
7.3	VISUAL GROUND SEGMENT					
7.3.S	Reserved					
7.3.R	A test is required to demonstrate that the visibility is correct on final approach in CAT II conditions and the positioning of the airplane is correct relative to the runway.				X	See Attachment 2 – Test 4.d.
7.3.G	Reserved					
8.	**FEATURE GENERAL REQUIREMENT**					

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
	MOTION CUES (not required)					
8.R	**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**	The motion system standards set out in part 60, Appendix A for at least Level A simulators is acceptable.
8.R	**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 part 60, Appendix A for at least Level A simulators is acceptable.
9.	**Reserved**					
10	**FEATURE GENERAL REQUIREMENT ENVIRONMENT — NAVIGATION**					
10.S	**Navigational data with the corresponding approach facilities to support the approved use. Navigation aids must be usable within range or line-of-sight without restriction, as applicable to the geographic area. A complete navigational database is required for at least 3 airport models**				**X**	
10.S1	**Navigational data with the corresponding approach facilities to support the approved use. Navigation aids must be usable within range or line-of-sight without restriction, as applicable to the geographic area. A complete navigational database is required for at least 1 airport model**			**X**		
10.R	**N/A.**					
10.G	**N/A.**					
	FEATURE TECHNICAL REQUIREMENT ENVIRONMENT - NAVIGATION					
10.1	NAVIGATION DATABASE					
10.1.S,S1	Navigation database sufficient to support simulated airplane systems for real world operations.			**X**	**X**	
10.1.R	N/A.					
10.1.G	N/A.					
10.2	MINIMUM AIRPORT REQUIREMENT					
10.2.S	Complete navigation database for at least 3 airports with corresponding precision and non-precision approach procedures, including regular updates.				**X**	Regular updates means navigation database updates as mandated by the NAA.
10.2.S1	Complete navigation database for at least 1 airport with corresponding precision and non-precision approach procedures, including regular updates.			**X**		
10.2.R	N/A.					
10.2.G	N/A.					
10.3	INSTRUCTOR CONTROLS					

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
10.3.S,S1	Instructor controls of internal and external navigational aids.			X	X	E.g. airplane ILS glideslope receiver failure compared to ground facility glideslope failure.
10.3.R	N/A.					
10.3.G	N/A.					
10.4	ARRIVAL / DEPARTURE FEATURES					
10.4.S,S1	Navigational data with all the corresponding standard arrival and departure procedures.			X	X	
10.4.R	N/A.					
10.4.G	N/A.					
10.5	NAVIGATION AIDS RANGE					
10.5.S,S1	Navigation aids must be usable within range or line-of-sight without restriction, as applicable to the geographic area.			X	X	Replication of the geographic environment with its specific limitations.
10.5.R	N/A.					
10.5.G	N/A.					
11	**FEATURE GENERAL REQUIREMENT** **ENVIRONMENT – ATMOSPHERE AND WEATHER**					
11.S	**N/A.**					
11.R	**Fully integrated dynamic environment simulation including a representative atmosphere with weather effects to support the approved use.** **The environment must be synchronized with appropriate airplane and simulation features to provide integrity. Environment simulation must include thunderstorms, wind shear, turbulence, microbursts and appropriate types of precipitation.**				X	
11.G	**Basic atmospheric model, pressure, temperature, and winds to support the approved use.** **The environment must be synchronized with appropriate airplane and simulation features to provide integrity.**			X		
	FEATURE TECHNICAL REQUIREMENT ENVIRONMENT – ATMOSPHERE AND WEATHER					
11.1	STANDARD ATMOSPHERE					
11.1.S	N/A.					
11.1.R,G	Simulation of the standard atmosphere including instructor control over key parameters.			X	X	
11.2	WIND SHEAR					
11.2.S	N/A.					
11.2.R	If the aircraft being simulated is one of the aircraft listed in § 121.358, Low-altitude windshear system equipment 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.				X	Refer to Attachment 2 – Test 2.g. The QTG should reference the FAA *Wind Shear Training Aid* or present alternate airplane-related data, including the

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
	(3) During initial climb. (4) On final approach, below 500 ft AGL. The QTG must reference the FAA Windshear Training Aid or present alternate airplane 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 training requirements of part 121 pertaining to a certificate holder's approved low-altitude windshear flight training program as described in § 121.409. 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. Any proposed alternate wind models used to meet this requirement must be properly supported and referenced in the Master QTG. Instructor Operating Station (IOS): All required windshear models must be selectable and clearly labeled on the Instructor Operating Station (IOS). Additionally, all IOS selectable windshear models must employ a method, such as a simulator preset, to ensure that the FFS is properly configured for use in training. This method must address variables such as windshear intensity, aircraft configurations (weights, flap settings, etc.), and ambient conditions to ensure that the proper windshear recognition cues and training objectives are present as originally qualified.					implementation method(s) used. If the alternate method is selected, wind models from the Royal Aeroplane Establishment (RAE) *Wind Shear Training*, the *Joint Airport Weather Studies (JAWS) Project* and other recognized sources may be implemented, but should be supported and properly referenced in the QTG. For Level 7FTDs, windshear training tasks may only be qualified for aircraft equipped with a synthetic stall warning system and the qualified windshear profile(s) are evaluated to ensure is the synthetic stall warning (and not the stall buffet) is first indication of the stall.
11.2.G	N/A					
11.3	WEATHER EFFECTS					
11.3.S	N/A.					
11.3.R	The following weather effects as observed on the visual system must be simulated and respective instructor controls provided.				X	
	(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.					Objective test required. Refer to Attachment 2 – Test 4.d.
	(4) Effects on ownship external lighting.					
	(5) Effects on airport lighting (including variable intensity and fog effects).					
	(6) Surface contaminants (including wind blowing effect).					
	(7) Variable precipitation effects (rain, hail, snow).					
	(8) In-cloud airspeed effect.					
	(9) Gradual visibility changes entering and breaking out of cloud.					
11.3 G	N/A					

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
11.4	INSTRUCTOR CONTROLS					
11.4.S	N/A.					
11.4.R	The following features must be simulated with appropriate instructor controls provided:				X	
	(1) surface wind speed, direction and gusts. Realistic gusting crosswind profiles must be available to the instructor 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 describing source data used to construct gusting crosswind profiles.					Programmed gusting crosswind intensity and rate of change should be based upon data sources such as the FAA Windshear Training Aid or other acceptable source data. Additional tuning of the gusting crosswind profile(s) by a subject matter expert pilot in order to achieve the required training objectives is encouraged.
	(2) intermediate and high altitude wind speed and direction;					
	(3) thunderstorms and microbursts; and					
	(4) turbulence.					For devices without motion, effects should be simulated on the instruments.
11.4.G	Environmental controls.			X		Controls for temperature, climate conditions, wind speed and direction.
12	**FEATURE GENERAL REQUIREMENT ENVIRONMENT – AIRPORTS AND TERRAIN**					
12.S	**N/A.**					
12.R	**Specific airport models with topographical features to support the approved use. When the FTD is being used by an instructor, or evaluator for the purposes of training, testing, or checking under this chapter, only Class I, Class II, or Class III models may be used by the instructor or evaluator. See Appendix A, Attachment 3, Paragraph 1 for additional QPS requirements concerning airport model usage.** **Correct terrain modeling, runway orientation, markings, lighting, dimensions and taxiways. Visual terrain and EGPWS databases must be matched to support training to avoid CFIT accidents.** **Where the device is required to perform low visibility operations, at least one airport scene with functionality to support the required approval type, e.g. low visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting.**				X	Class I airport model requirements for Level 7 FTDs are defined in Table B3B of this Appendix. Class II airport model requirements are defined in Table A3C of Appendix A. Class III airport model requirements are defined in Appendix F of this Part. Additional information concerning the usage of Class III airport models can be found in Appendix A, Attachment 3 of the Part.
12.R1	**The FTD may have a visual system, if desired, although it is not required. If a visual system is installed, the visual scene content must not be distracting and must be modeled to the extent to support the approved use.**	X	X	X		
12.R(S)	**Reserved**					
12.G	**Reserved**					
12.G(S)	**Reserved**					

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
12.1	VISUAL CUES					
12.1.1R(S) G(S)	Reserved					
12.1.1R	Visual cues to assess sink rate and depth perception during take-off and landing must be provided. This must include: (1) surface on runways, taxiways, and ramps; (2) terrain features; and (3) highly detailed and accurate surface depiction of the terrain surface within an approximate area from 400 m (1/4 sm) before the runway approach end to 400 m (1/4 sm) beyond the runway departure end with a total width of approximately 400 m (1/4 sm) including the width of the runway.				X	
12.1.1G	Reserved					
12.2	VISUAL EFFECTS					
12.2.1R	The system 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	
12.3	ENVIRONMENT ATTITUDE					
12.3.1R	The FSTD must provide for accurate portrayal of the visual environment relating to the FSTD attitude.				X	Visual attitude versus FSTD attitude is a comparison of pitch and roll of the horizon as displayed in the visual scene compared to the display on the attitude indicator. Required for initial qualification only (SOC acceptable).
12.4	AIRPORT SCENES					
12.4.1R	The system must include at least 3 designated real-world airports available in daylight, twilight (dusk or dawn) and night illumination states.				X	The designated real-world airports should be part of the approved training program.
12.4.1G	Reserved					
12.4.2.1R	Daylight Capability. SOC required for system capability.				X	System objective tests are required. See Attachment 2 (visual scene quality) — Test 4.a.
12.4.2.2R	The system must provide full-color presentations and sufficient surfaces with appropriate textural cues to successfully accomplish a visual approach, landing and airport movement (taxi).				X	
12.4.2.3R	Surface shading effects must be consistent with simulated sun position.				X	This does not imply continuous time of day.

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
12.4.2.4R	Total scene content comparable in detail to that produced by 10 000 visible textured surfaces and 6 000 visible lights must be provided.				X	
12.4.2.4G	Reserved					
12.4.2.5R	The system must have sufficient capacity to display 16 simultaneously moving objects.				X	
12.4.3.1R	Twilight (dusk) capability.				X	
12.4.3.2R	The system must provide twilight (or dusk) visual scenes with full color presentations of reduced ambient intensity and typical terrain characteristics such as fields, roads and bodies of water and surfaces illuminated by representative ownship lighting (e.g. landing lights) sufficient to successfully accomplish visual approach, landing and airport movement (taxi).				X	
12.4.3.3R	Total scene content comparable in detail to that produced by 10 000 visible textured surfaces and 15 000 visible lights must be provided.				X	
12.4.3.3R	Scenes must include self-illuminated objects such as road networks, ramp lighting and airport signage, to conduct a visual approach, landing and airport movement (taxi).				X	
12.4.3.4R	The system must include a definable horizon.				X	If provided, directional horizon lighting should have correct orientation and be consistent with surface shading effects.
12.4.3.6R	The system must have sufficient capacity to display 16 simultaneously moving objects.				X	
12.4.4R	Night capability.				X	
12.4.4.1R	The system must 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 airplane lights (e.g. landing lights).				X	
12.5	AIRPORT CLUTTER					
12.5.1R	Airport models must include representative static and dynamic clutter such as gates, airplanes, and ground handling equipment.				X	Clutter need not be dynamic unless required (e.g. ATC correlation).
12.6	DATABASE CURRENCY					
12.6.1R	Reserved					
12.7	Reserved					
12.8	Reserved					
12.9	LOW VISIBILITY TRAINING					
12.9.1R	The system must include at least one airport scene with functionality to support the required approval type, e.g. low visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting.				X	
13	**FEATURE GENERAL REQUIREMENT MISCELLANEOUS**					
13.S	**N/A.**				X	
13.S1	**N/A.**					
13.R	**N/A.**					
13.G	**N/A.**					
13	FEATURE TECHNICAL REQUIREMENT					

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
	MISCELLANEOUS					
13.1	INSTRUCTOR OPERATING STATION					
13.1S,S1	The instructor station must provide an adequate view of the pilots' panels and forward windows.	X	X	X	X	
13.1G	N/A.					
13.2	INSTRUCTOR CONTROLS					
13.2 S,S1	Instructor controls must be provided for all required system variables, freezes, resets and for insertion of malfunctions to simulate abnormal or emergency conditions. The effects of these malfunctions must be sufficient to correctly exercise the procedures in relevant operating manuals.	X	X	X	X	
13.3	SELF–DIAGNOSTIC TESTING					
13.3S,S1	Self-diagnostic testing of the FSTD must be available to determine the integrity of hardware and software operation and to provide a means for quickly and effectively conducting daily testing of the FSTD software and hardware. An SOC is required	X	X	X	X	
13.4	COMPUTER CAPACITY					
13.4 S,S1	Sufficient FSTD computer capacity, accuracy, resolution and dynamic response must be provided to fully support the overall FSTD fidelity needed to meet the qualification level sought. An SOC is required.	X	X	X	X	
13.5	AUTOMATIC TESTING FACILITIES					
13.5S	Automatic QTG/validation testing of FSTD hardware and software to determine compliance with the validation requirements must 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 airplane standard.
13.5 R,G	Reserved					
13.6	UPDATES TO FSTD HARDWARE AND SOFTWARE					
13.6S	Timely permanent update of FSTD hardware and software must be conducted subsequent to airplane modification where it affects training, sufficient for the qualification type sought.			X	X	
13.6G	Reserved					
13.7	DAILY PRE-FLIGHT DOCUMENTATION					
13.7 S,S1	Daily pre-flight documentation either in the daily log or in a location easily accessible for review is required.	X	X	X	X	
13.8	SYSTEM INTEGRATION					
13.8	System Integration. Relative response of the visual system, cockpit/flight deck instruments and initial motion system coupled closely to provide integrated sensory cues. Visual scene changes from steady state disturbance (i.e. the start of the scan of the first video field containing different information) must occur within the system dynamic response limit of 100 milliseconds (ms). Motion onset must also occur within the system dynamic response limit of 100 ms. While motion onset must occur before the start of the scan of the first video field containing different information, it needs to occur					Test required. See Attachment 2, Transport delay – Test 6.a. Latency test may be used as an alternate means of compliance in place of the transport delay test.

Table B1A - Minimum FTD Requirements						
	QPS REQUIREMENTS	FTD Level				INFORMATION
Entry Number	General FTD Requirements	4	5	6	7	Notes
	before the end of the scan of the same video field. The test to determine compliance with these requirements must include simultaneously recording the output from the pilot's pitch, roll and yaw controllers, the output from the accelerometer attached to the motion system platform located at an acceptable location near the pilots' seats, the output signal to the visual system display (including visual system analogue delays) and the output signal to the pilot's attitude indicator or an equivalent test approved by the NSPM.					Appendix A, Attachment 2, Paragraph 15 provides guidance for transport delay test methodology and also latency.
13.8S	Transport delay: A transport delay test may be used to demonstrate that the FSTD system response does not exceed 100 ms. Where EFVS systems are installed, they must respond within + or - 30 ms from the visual system, and not before the motion response.				X	Results required for instruments, motion and visual systems. Additional transport delay test results are required where HUD systems are installed, which are simulated and not actual airplane systems. Where a visual system's mode of operation (daylight, twilight and night) can affect performance, additional tests are required. An SOC is required where the visual system's mode of operation does not affect performance, precluding the need to submit additional tests.
13.8S1	Transport delay: A transport delay test may be used to demonstrate that the FSTD system response does not exceed 300 ms. Where EFVS systems are installed, they must respond within + or - 30 ms from the visual system, and not before the motion response.		X	X		Results required for instruments, motion and visual systems. Additional transport delay test results are required where HUD systems are installed, which are simulated and not actual airplane systems. Where a visual system's mode of operation (daylight, twilight and night) can affect performance, additional tests are required. An SOC is required where the visual system's mode of operation does not affect performance, precluding the need to submit additional tests.
13.8 R,G	Reserved					

Table B1B

Table of Tasks vs. FTD Level						
QPS REQUIREMENTS						INFORMATION
Entry Number	Subjective Requirements In order to be qualified at the FTD qualification level indicated, the FTD must be able to perform at least the tasks associated with that level of qualification. See Notes 1 and 2 at the end of the Table	FTD Level				Notes
		4	5	6	7	
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**	**X**	**X**	
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 (requires visual system)			**A**	**X**	
2.e.	Departure Procedure		**X**	**X**	**X**	
3. Inflight Maneuvers.						
3.a.	Steep Turns		**X**	**X**	**X**	
3.b	Approaches to Stalls		**A**	**X**	**X**	Approach to stall maneuvers qualified only where the aircraft does not exhibit stall buffet as the first indication of the stall.
3.c.	Engine Failure—Multiengine Airplane		**A**	**X**	**X**	
3.d.	Engine Failure—Single-Engine Airplane		**A**	**X**	**X**	
3.e.	Specific Flight Characteristics incorporated into the user's FAA approved flight training program.	**A**	**A**	**A**	**A**	
3.f.	Windshear Recovery				**T**	For Level 7 FTD, windshear recovery may be qualified at the Sponsor's option. See Table B1A for specific requirements and limitations.
4. Instrument Procedures.						
4.a.	Standard Terminal Arrival / Flight Management System Arrivals Procedures		**A**	**X**	**X**	
4.b.	Holding		**A**	**X**	**X**	
4.c.	Precision Instrument					
4.c.1.	All engines operating.		**A**	**X**	**X**	e.g., Autopilot, Manual (Flt. Dir. Assisted), Manual (Raw Data)
4.c.2.	One engine inoperative.				**T**	e.g., Manual (Flt. Dir. Assisted), Manual (Raw Data)

Table B1B

Table of Tasks vs. FTD Level						
QPS REQUIREMENTS						**INFORMATION**
Entry Number	**Subjective Requirements** In order to be qualified at the FTD qualification level indicated, the FTD must be able to perform at least the tasks associated with that level of qualification. See Notes 1 and 2 at the end of the Table	**FTD Level**				**Notes**
		4	**5**	**6**	**7**	
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 Airplane				**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.b.	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**	
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. Postflight Procedures.						

Table B1B

Table of Tasks vs. FTD Level						
QPS REQUIREMENTS						**INFORMATION**
Entry Number	**Subjective Requirements** In order to be qualified at the FTD qualification level indicated, the FTD must be able to perform at least the tasks associated with that level of qualification. See Notes 1 and 2 at the end of the Table	**FTD Level**				**Notes**
		4	**5**	**6**	**7**	
8.a.	After-Landing Procedures		**A**	**X**	**X**	
8.b.	Parking and Securing		**A**	**X**	**X**	

Note 1: An "A" in the table 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 2: Items not installed or not functional on the FTD and not appearing on the SOQ Configuration List, are not required to be listed as exceptions on the SOQ.

Note 3: A "T" in the table indicates that the FTD may only be qualified for initial or recurrent qualification training. These tasks may not be qualified for proficiency testing or checking credits in an FAA approved flight training program.

Table B1C

Table of FTD System Tasks						
QPS REQUIREMENTS						**INFORMATION**
Entry Number	**Subjective Requirements** In order to be qualified at the FTD qualification level indicated, the FTD must be able to perform at least the tasks associated with that level of qualification.	**FTD Level**				**Notes**
		4	**5**	**6**	**7**	
1. Instructor Operating Station (IOS), as appropriate.						
1.a.	Power switch(es).	**X**	**X**	**X**	**X**	
1.b.	Airplane conditions.	**A**	**X**	**X**	**X**	e.g., GW, CG, Fuel loading and Systems.
1.c.	Airports / Runways.	**X**	**X**	**X**	**X**	e.g., Selection, Surface, Presets, Lighting controls.
1.d.	Environmental controls.	**X**	**X**	**X**	**X**	e.g., Clouds, Visibility, RVR, Temp, Wind, Ice, Snow, Rain, and Windshear.
1.e.	Airplane system malfunctions (Insertion / deletion)	**A**	**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.	**A**	**A**	**A**	**A**	
4. Observer Seats / Stations.						
4.a.	Position / Adjustment / Positive restraint system.	**X**	**X**	**X**	**X**	

Note 1: An "A" in the table indicates that the system, task, or procedure, although not required to be present, may be examined if the appropriate system is in the FTD and is working properly.

Attachment 2 to Appendix B to Part 60—Flight Training Device (FTD) Objective Tests

Begin Information

1. Discussion

a. For the purposes of this attachment, the flight conditions specified in the Flight Conditions Column of Table B2A, are defined as follows:

(1) Ground—on ground, independent of airplane configuration;

(2) Take-off—gear down with flaps/slats in any certified takeoff position;

(3) First segment climb—gear down with flaps/slats in any certified takeoff position (normally not above 50 ft AGL);

(4) Second segment climb—gear up with flaps/slats in any certified takeoff position (normally between 50 ft and 400 ft AGL);

(5) Clean—flaps/slats retracted and gear up;

(6) Cruise—clean configuration at cruise altitude and airspeed;

(7) Approach—gear up or down with flaps/slats at any normal approach position as recommended by the airplane manufacturer; and

(8) Landing—gear down with flaps/slats in any certified landing position.

b. The format for numbering the objective tests in Appendix A, Attachment 2, Table A2A, and the objective tests in Appendix B, Attachment 2, Table B2A, is identical. However, each test required for FFSs is not necessarily required for FTDs. Also, each test required for FTDs is not necessarily required for FFSs. Therefore, 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 FFSs or FTDs.

c. The reader is encouraged to review the Airplane Flight Simulator Evaluation Handbook, Volumes I and II, published by the Royal Aeronautical Society, London, UK, and FAA AC 25–7, as amended, Flight Test Guide for Certification of Transport Category Airplanes, and AC 23–8, as amended, Flight Test Guide for Certification of Part 23 Airplanes, for references and examples regarding flight testing requirements and techniques.

d. 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.

e. A Level 4 FTD does not require objective tests and therefore, Level 4 is not addressed in the following table.

End Information

Begin QPS Requirements

2. Test Requirements

a. The ground and flight tests required for qualification are listed in Table B2A Objective Tests. Computer generated FTD test results must be provided for each test except where an alternate test is specifically authorized by the NSPM. If a flight condition or operating condition is required for the test but does not apply to the airplane being simulated or to the qualification level sought, it may be disregarded (e.g., an engine out missed approach for a single-engine airplane; a maneuver using reverse thrust for an airplane without reverse thrust capability). Each test result is compared against the validation data described in § 60.13, and in Appendix B. The results must be produced on an appropriate recording device acceptable to the NSPM and must include FTD number, date, time, conditions, tolerances, and appropriate dependent variables portrayed in comparison to the validation data. Time histories are required unless otherwise indicated in Table B2A. All results must be labeled using the tolerances and units given.

b. Table B2A in this attachment sets out the test results required, including the parameters, tolerances, and flight conditions for FTD validation. Tolerances are provided for the listed tests because mathematical modeling and acquisition and development of reference data are often inexact. All tolerances listed in the following tables are applied to FTD performance. When two tolerance values are given for a parameter, the less restrictive 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.

c. Certain tests included in this attachment must be supported with a SOC. In Table B2A, requirements for SOCs are indicated in the ''Test Details'' column.

d. When operational or engineering judgment is used in making assessments for flight test data applications for FTD validity, such judgment may not be limited to a single parameter. For example, data that exhibit rapid variations of the measured parameters may require interpolations or a ''best fit'' data section. All relevant parameters related to a given maneuver or flight condition must be provided to allow overall interpretation. When it is difficult or impossible to match FTD to airplane data throughout a time history, differences must be justified by providing a comparison of other related variables for the condition being assessed.

e. It is not acceptable to program the FTD so that the mathematical modeling is correct only at the validation test points. Unless noted otherwise, tests must represent airplane 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 is necessary. Certain tests that are relevant only at one extreme CG or weight condition need not be repeated at the other extreme. The results of the tests for Level 6 are expected to be indicative of the device's performance and handling qualities throughout all of the following:

(1) The airplane weight and CG envelope;

(2) The operational envelope; and

(3) Varying atmospheric ambient and environmental conditions—including the extremes authorized for the respective airplane or set of airplanes.

f. When comparing the parameters listed to those of the airplane, sufficient data must also be provided to verify the correct flight condition and airplane configuration changes. For example, to show that control force is within the parameters for a static stability test, data to show the correct airspeed, power, thrust or torque, airplane configuration, altitude, and other appropriate datum identification parameters must also be given. If comparing short period dynamics, normal acceleration may be used to establish a match to the airplane, but airspeed, altitude, control input, airplane configuration, and other appropriate data must also be given. If comparing landing gear change dynamics, pitch, airspeed, and altitude may be used to establish a match to the airplane, but landing gear position must also be provided. 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).

g. The QTG provided by the sponsor must clearly describe how the FTD will be set up and operated for each test. Each FTD subsystem may be tested independently, but overall integrated testing of the FTD must be accomplished to assure that the total FTD system meets the prescribed standards. A manual test procedure with explicit and detailed steps for completing each test must also be provided.

h. For previously qualified FTDs, the tests and tolerances of this attachment may be used in subsequent continuing qualification evaluations for any given test if the sponsor has submitted a proposed MQTG revision to the NSPM and has received NSPM approval.

i. FTDs are evaluated and qualified with an engine model simulating the airplane data supplier's flight test engine. For qualification of alternative engine models (either variations of the flight test engines or other manufacturer's engines) additional tests with the alternative engine models may be required. This attachment contains guidelines for alternative engines.

j. Testing Computer Controlled Aircraft (CCA) simulators, or other highly augmented airplane simulators, flight test data is required for the Normal (N) and/or Non-normal (NN) control states, as indicated in this attachment. Where test results are independent of control state, Normal or Non-normal control data may be used. All tests in Table B2A require test results in the Normal control state unless specifically noted otherwise in the Test Details section following the CCA designation. The NSPM will determine what tests are appropriate for airplane simulation data. When making this determination, the NSPM may require other levels of control state degradation for specific airplane 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:

(1) Pilot controller deflections or electronically generated inputs, including location of input; and

(2) Flight control surface positions unless test results are not affected by, or are independent of, surface positions.

k. Tests of handling qualities must include validation of augmentation devices. FTDs for highly augmented airplanes will be validated both in the unaugmented configuration (or failure state with the maximum permitted degradation in handling qualities) and the augmented configuration. Where various levels of handling qualities result from failure states, validation of the effect of the failure is necessary. Requirements for testing will be mutually agreed to between the sponsor and the NSPM on a case-by-case basis.

l. Some tests will not be required for airplanes using airplane hardware in the FTD flight deck (e.g., ''side stick controller''). These exceptions are noted in Section 2 ''Handling Qualities'' in Table B2A of this attachment. However, in these cases, the sponsor must provide a statement that the airplane hardware meets the appropriate manufacturer's specifications and the sponsor must have supporting information to that fact available for NSPM review.

m. For objective test purposes, see Appendix F of this part for the definitions of ''Near maximum,'' ''Light,'' and ''Medium'' gross weight.

End QPS Requirements

Begin Information

n. In those cases where the objective test results authorize a ''snapshot test'' or a ''series of snapshot test results'' in lieu of a time-history result, the sponsor or other data provider must ensure that a steady state condition exists at the instant of time captured by the ''snapshot.'' The steady state condition must exist from 4 seconds prior to, through 1 second following, the instant of time captured by the snap shot.

o. Refer to AC 120–27, ''Aircraft Weight and Balance;'' and FAA–H–8083–1, ''Aircraft Weight and Balance Handbook'' for more information.

End Information

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
1. Performance.								
1.a.	**Taxi.**							
1.a.1	Minimum radius turn.	±0.9 m (3 ft) or ±20% of airplane 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 airplanes 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.— 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).*				
1.b.1	Ground acceleration time and distance.	±1.5 s or ±5% of time; and ±61 m (200 ft) or ±5% of distance. For 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 V_r. 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.
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 airplane lateral deviation reached or ±1.5 m (5 ft). For airplanes with reversible flight control systems: ±10% or ±2.2 daN (5 lbf) rudder pedal force.	Takeoff.	Engine failure speed must be within ±1 kt of airplane 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 airplane manufacturer's flight test engine, a further test may be run with the same initial conditions using the thrust from the flight test data as the driving parameter. To ensure only aerodynamic control, nosewheel steering must be disabled (i.e. castored) or the nosewheel held slightly off the ground.			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 V_1 and V_1-10 kt, followed by control of heading using aerodynamic control only and recovery should be achieved with the main gear on the ground.

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	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 airplane, should be active.
1.b.4	Normal take-off.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±6 m (20 ft) height. For airplanes 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 airplane has more than one certificated take-off 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.
1.b.5	Critical engine failure on take-off.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±6 m (20 ft) height.	Takeoff.	Record takeoff profile to at least 61 m (200 ft) AGL. Engine failure speed must be within ±3 kt of airplane data.			X	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		±2° roll angle. ±2° side-slip angle. ±3° heading angle. For airplanes 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.		Test at near maximum takeoff weight				
1.b.6	Crosswind take-off.	± 3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±6 m (20 ft) height. ±2° roll angle. ±2° side-slip angle. ±3° heading angle. Correct trends at ground speeds below 40 kt for rudder/pedal and heading angle. For airplanes with reversible flight control systems:	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 airplane 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 NSPM.

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		±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.						
1.b.7.	Rejected Takeoff.	±5% of time or ±1.5 s. ±7.5% of distance or ±76 m (250 ft). For Level 6 FTD: ±5% of time or ±1.5 s.	Takeoff.	Record at mass near maximum takeoff weight. Speed for reject must be at least 80% of V_1. 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	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 airplane 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, airplane flight test may be performed out of ground effect at a safe altitude, but with correct airplane configuration and airspeed.
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, airplane performance manual data are an acceptable alternative. Record at nominal climb speed and mid initial climb altitude.	X	X	X	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
				FSTD performance is to be recorded over an interval of at least 300 m (1 000 ft).				
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 airplane performance data requirements.	2nd segment climb.	Flight test data is preferred; however, airplane 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	
1.c.3.	One Engine Inoperative En route Climb.	±10% time, ±10% distance, ±10% fuel used	Clean	Flight test data or airplane performance manual data may be used. Test for at least a 1550 m (5 000 ft) segment.			X	
1.c.4.	One Engine Inoperative Approach Climb for airplanes with icing accountability if provided in the airplane 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 airplane performance data.	Approach	Flight test data or airplane 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	Airplane 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 airplane 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 airplanes with a small operating speed range, speed change may be reduced to 80% of operational speed change.			X	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	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 airplanes 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	
1.d.5.	Emergency descent.	±5 kt airspeed. ±1.5 m/s (300 ft/min) or ±5% of rate of descent.	As per airplane 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 weight. Engineering data may be used for the medium weight condition.			X	
1.e.2.	Deceleration time and distance, reverse thrust, no wheel brakes, dry runway.	±1.5 s or ±5% of time; and the smaller of ±61 m	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.			X	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		(200 ft) or ±10% of distance.		Position of ground spoilers must be plotted (if applicable). Data required for medium and near maximum certificated landing weight. Engineering data may be used for the medium weight condition.				
1.e.3.	Stopping distance, wheel brakes, wet runway.	±61 m (200 ft) or ±10% of distance.	Landing.	Either flight test or manufacturer's performance manual data 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.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.	±10% Ti or ±0.25 s; and ±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 Appendix F of this part for definitions of T_i and T_t.
1.f.2.	Deceleration.	±10% Ti or ±0.25 s; and ±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 maximum take-off power to idle power.	**X**	**X**	**X**	See Appendix F of this part for definitions of T_i and T_t.
2. Handling Qualities.								
	Note 1.— Pitch, roll and yaw controller position versus force or time must 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 airplane 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							Contact the NSPM for clarification of any issue regarding airplanes with reversible controls.

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
	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 must be accomplished at the same feel or impact pressures as the validation data where applicable. *Note 2.— FSTD 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.	**Static Control Tests.**							
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.
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

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
								data.
2.a.3.a.	Rudder pedal position versus force and surface position calibration.	±2.2 daN (5 lbf) breakout. ±2.2 daN (5 lbf) or ±10% of force. ±2° rudder angle.	Ground.	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. ±2° rudder angle.	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 of an uninterrupted control sweep to the stops.			X	
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 of an uninterrupted control sweep to the stops.		X		
2.a.5.	Rudder Pedal Steering Calibration.	±2° NWA.	Ground.	Record results of 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 the FTD surface position and indicator against the software 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			X	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
				be used.				
2.a.8.	Alignment of cockpit throttle lever versus selected engine parameter.	When matching engine parameters: ±5° of TLA. When matching detents: ±3% N1 or ±.03 EPR or ±3% torque, or equivalent. Where the levers do not have angular travel, a tolerance of ±2 cm (±0.8 in) applies.	Ground.	Simultaneous recording for all engines. The tolerances apply against airplane data. For airplanes with throttle detents, all detents to be presented and at least one position between detents/ endpoints (where practical). For airplanes without detents, end points and at least three other positions are to be presented.		X	X	Data from a test airplane or engineering test bench are acceptable, provided the correct engine controller (both hardware and software) is used. In the case of propeller-driven airplanes, 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.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.
2.a.10	Stick Pusher System Force Calibration	±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 to prevent an aerodynamic stall. 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 NSPM. Test requirement may be met through column force validation testing in conjunction with the Stall Characteristics test (2.c.8).
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 airplane controller unit installed in the FSTD. Power setting may be that required for level flight unless otherwise specified. See paragraph 4 of Appendix A, Attachment 2.							

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
2.b.1.	Pitch Control.	**For underdamped systems**: $T(P_0)$ ±10% of P_0 or ±0.05 s. $T(P_1)$ ±20% of P_1 or ±0.05 s. $T(P_2)$ ±30% of P_2 or ±0.05 s. $T(P_n)$ ±10*(n+1)% of P_n or ±0.05 s. $T(A_n)$ ±10% of A_{max}, where A_{max} is the largest amplitude or ±0.5% of the total control travel (stop to stop). $T(A_d)$ ±5% of A_d = residual band or ±0.5% of the maximum control travel = residual band. ±1 significant overshoots (minimum of 1 significant overshoot). Steady state position within residual band. *Note 1.— Tolerances should not be applied on period or amplitude after the last significant overshoot.*	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 paragraph 4 of Appendix A, Attachment 2.

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		Note 2.— Oscillations within the residual band are not considered significant and are not subject to tolerances. **For overdamped and critically damped systems only**, the following tolerance applies: $T(P_0)$ ±10% of P_0 or ±0.05 s.						
2.b.2.	Roll Control.	Same as 2.b.1.	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 paragraph 4 of Appendix A, Attachment 2.
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 paragraph 4 of Appendix A, Attachment 2.
2.b.4.	Small Control Inputs – Pitch.	±0.15°/s body pitch rate or ±20% of peak body pitch rate applied throughout the time history.	Approach or Landing.	Control inputs 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**	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
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 airplanes 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	
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	
2.c.	**Longitudinal Control Tests.**							
	Power setting is that required for level flight unless otherwise specified.							
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.			X	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
				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				
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**		
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**	
2.c.4.a.	Gear Change Dynamics.	±3 kt airspeed. ±30 m (100 ft) altitude.	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			**X**	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		±1.5° or ±20% of pitch angle.		+ 15 s. **CCA:** Test in normal and non-normal control mode				
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**		
2.c.5.	Longitudinal Trim.	±1° elevator angle. ±0.5° stabilizer angle. ±1° pitch angle. ±5% of net thrust or equivalent.	Cruise, Approach, and Landing.	Steady-state wings level trim with thrust for level flight. This test may be a series of snapshot tests. 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**	
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 airplane hardware in the FSTD. Alternative method applies to airplanes which do not exhibit stick-force-per-g characteristics. **CCA:** Test in normal or non-normal control mode		**X**	**X**	
2.c.7.	Longitudinal Static Stability.	±2.2 daN (5 lbf) or ±10% of pitch controller force. Alternative method:	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.	**X**	**X**	**X**	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		±1° or ±10% of the change of elevator angle.		This test may be a series of snapshot tests. Force tolerance is not applicable if forces are generated solely by the use of airplane hardware in the FSTD. Alternative method applies to airplanes which do not exhibit speed stability characteristics. Level 5 must exhibit positive static stability, but need not comply with the numerical tolerance. **CCA:** Test in normal or non-normal control mode, as applicable.				
2.c.8	Approach to Stall Characteristics (actuation of stall warning device)	±3 kt airspeed for initial buffet, stall warning, and stall speeds. 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).	Second Segment Climb, High Altitude Cruise (Near Performance Limited Condition), and Approach or Landing	Each of the following stall entry methods must be demonstrated in at least one of the three required 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) The required cruise condition must be conducted in a flaps-up (clean) configuration. The second segment climb and approach/landing conditions must be conducted at different flap settings. 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 A of this Part.		**X**	**X**	Tests may be conducted at centers of gravity typically required for airplane certification stall testing.
2.c.9.a.	Phugoid Dynamics.	±10% of period. ±10% of time to one half or double amplitude or	Cruise.	Test must include three full cycles or that necessary to determine time to one half or double amplitude, whichever is less.		**X**	**X**	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		±0.02 of damping ratio.		**CCA:** Test in non-normal control mode.				
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. **CCA:** Test in Non-normal control mode.	**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**	
2.c.11.	**(Reserved)**							
2.d.	**Lateral Directional Tests.**							
	Power setting is that required for level flight unless otherwise specified.							
2.d.1.	Minimum control speed, air (V_{mca}) or landing (V_{mcl}), per applicable airworthiness requirement or low speed engine-inoperative handling characteristics in the air.	±3 kt airspeed.	Takeoff or Landing (whichever is most critical in the airplane).	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**	Minimum speed may be defined by a performance or control limit which prevents demonstration of V_{mca} or V_{mcl} in the conventional manner.
2.d.2.	Roll Response (Rate).	±2°/s or ±10% of roll rate. For airplanes with reversible flight control systems (Level 7 FTD only): ±1.3 daN (3 lbf) or ±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.	±2° or ±10% of roll angle.	Approach or Landing.	This test may be combined with roll response (rate) test 2.d.2.		**X**	**X**	With wings level, apply a step roll control input using approximately one-third of the

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
				CCA: Test in normal and non-normal control mode				roll controller travel. When reaching approximately 20° to 30° of bank, abruptly return the roll controller to neutral and allow approximately 10 seconds of airplane free response.
2.d.4.a.	Spiral Stability.	Correct trend and ±2° or ±10% of roll angle in 20 s. If alternate test is used: correct trend and ±2° aileron angle.	Cruise, and Approach or Landing.	Airplane 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 ±3° or ±10% of roll angle in 30 s. If alternate test is used: correct trend and ±2° aileron angle.	Cruise	Airplane 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.c.	Spiral Stability.	Correct trend	Cruise	Airplane data averaged from multiple tests may be used. **CCA:** Test in non-normal control mode.	**X**			
2.d.5.	Engine Inoperative Trim.	±1° rudder angle or ±1° tab angle or equivalent rudder pedal. ±2° 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.
2.d.6.a.	Rudder Response.	±2°/s or ±10% of yaw	Approach or Landing.	Test with stability augmentation on and off.		**X**	**X**	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		rate.		Test with a step input at approximately 25% of full rudder pedal throw. **CCA:** Test in normal and non-normal control mode				
2.d.6.b.	Rudder Response.	Roll rate ±2°/sec, bank angle ±3°.	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.
2.d.7.	Dutch Roll	±0.5 s or ±10% of period. ±10% of time to one half or double amplitude or +.02 of damping ratio. (Level 7 FTD only): +1 s or ±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.	Approach or Landing.	This test may be a series of snapshot tests using at least two rudder positions (in each direction for propeller-driven airplanes), 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**	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		For airplanes with reversible flight control systems (Level 7 FTD only): ±1.3 daN (3 lbf) or ±10% of wheel force. ±2.2 daN (5 lbf) or ±10% of rudder pedal force.						
2.e.	**Landings.**							
2.e.1.	Normal Landing.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±3 m (10 ft) or ±10% of height. For airplanes 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.
2.e.2.	Minimum Flap Landing.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA. ±3 m (10 ft) or ±10% of height.	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	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		For airplanes with reversible flight control systems: ±2.2 daN (5 lbf) or ±10% of column force.						
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 airplanes with reversible flight control systems: ±2.2 daN (5 lbf) or ±10% of column force. ±1.3 daN (3 lbf) or ±10% of wheel force. ±2.2 daN (5 lbf) or ±10% of rudder pedal force.	Landing.	Test from a minimum of 61 m (200 ft) AGL to a 50% decrease in main landing gear touchdown speed. It requires test data, including wind profile, for a crosswind component of at least 60% of airplane 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 NSPM.
2.e.4.	One Engine Inoperative Landing.	±3 kt airspeed. ±1.5° pitch angle.	Landing.	Test from a minimum of 61 m (200 ft) AGL to a 50% decrease in main landing gear touchdown speed.			**X**	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		±1.5° AOA. ±3 m (10 ft) or ±10% of height. ±2° roll angle. ±2° side-slip angle. ±3° heading angle.						
2.e.5.	Autopilot landing (if applicable).	±1.5 m (5 ft) flare height. ±0.5 s or ± 10% of Tf. ±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 Appendix F of this part for definition of T_f.
2.e.6.	All-engine autopilot go-around.	±3 kt airspeed. ±1.5° pitch angle. ±1.5° AOA.	As per airplane performance data.	Normal all-engine autopilot go-around must be demonstrated (if applicable) at medium weight.			**X**	
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 airplane 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	±5 kt airspeed.	Landing.	Apply rudder pedal input in both directions using			**X**	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
	(rudder effectiveness) with symmetric reverse thrust.	±2°/s yaw rate.		full reverse thrust until reaching full thrust reverser minimum operating speed.				
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.**							
	Test to demonstrate Ground Effect.	±1° elevator angle. ±0.5° stabilizer angle. ±5% of net thrust or equivalent. ±1° AOA. ±1.5 m (5 ft) or ±10% of height. ±3 kt airspeed. ±1° pitch angle.	Landing.	A rationale must be provided with justification of results. **CCA:** Test in normal or non-normal control mode, as applicable.			X	See paragraph on Ground Effect in this attachment for additional information.
2.g.	**Windshear**							
	Four tests, two takeoffs and two landing, with one of each conducted in still air and the other with windshear active to demonstrate windshear models.	See Attachment 5 of Appendix A.	Takeoff and Landing.	Requires windshear models that provide training in the specific skills needed to recognize windshear phenomena and to execute recovery procedures. See Attachment 5 of this Appendix A for tests, tolerances, and procedures.			X	Tests required only for those Level 7 FTDs qualified for windshear training tasks.
2.h.	**Flight Maneuver and Envelope Protection Functions.**							
	Note. — The requirements of 2.h are only applicable to computer-controlled airplanes. 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	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
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	Second Segment Climb, and Approach or Landing.				X	
2.i.	Engine and Airframe Icing Effects Demonstration (Aerodynamic Stall)		Takeoff, Approach, or Landing	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 B1A, Section 2.1.5.S. Test must include rationale that describes the icing effects being demonstrated. Icing effects must include, but are not limited to the following effects as applicable to the particular airplane: ▪ 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 onset. ▪ Engine effects (power reduction/variation, vibration, etc.)			X	Tests will be evaluated for representative effects on relevant aerodynamic 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. Reserved								
4. Visual System.								

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
4.a.	**Visual scene quality**							
4.a.1.	Continuous cross-cockpit visual field of view.	Visual display providing each pilot with a minimum of 200° horizontal and 40° vertical continuous field of view.	Not applicable.	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 must have no distracting discontinuities.	Not applicable				X	
4.a.3	Surface resolution (object detection).	Not greater than 4 arc minutes.	Not applicable.				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. The object will subtend 4 arc minutes to the eye. This may be demonstrated using threshold bars for a horizontal test. A vertical test should also be demonstrated. The subtended angles should be confirmed by calculations in an SOC.
4.a.4	Light point size.	Not greater than 8 arc minutes.	Not applicable.				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

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
								light points relative to the eyepoint in all axes. At a point where modulation is just discernible in each visual channel, a calculation should be made to determine the light spacing. An SOC is required to state test method and calculation.
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/m^2 (2 ft-lamberts). Measure any adjacent dark squares. The contrast ratio is the bright square value divided by the dark square value. *Note 1. — During contrast ratio testing, FSTD aft-cab and flight deck ambient light levels should be as low as possible.* *Note 2. — Measurements should be taken at the center of*

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
								squares to avoid light spill into the measurement device.
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. — 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. — During contrast ratio testing, FSTD aft-cab and flight deck ambient light levels should be as low as practical.*
4.a.7	Light point brightness.	Not less than 20 cd/m^2 (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/m^2 (4.1 ft-lamberts) on the	Not applicable.				**X**	Surface brightness should be measured on a white raster,

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		display.						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)**							
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.					**X**	Alignment requirement only applies to the pilot flying.
4.b.2	System display.	All functionality in all flight modes must be demonstrated.					**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**	
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**	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	Flight				**X**	Infra-red scene representative of both 350 m (1 200 ft), and

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		(1200 ft) and 1609 m (1 sm) RVR including correct light intensity.						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. Far end: ±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 airplane'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 be described and included in the slant range visibility calculation used in the VGS computation.*			X	Pre-position for this test is encouraged but may be achieved via manual or autopilot control to the desired position.
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

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
								points, and moving models should be displayed simultaneously.
4.e.2	System capacity – Twilight/night mode.	Not less than: 10 000 visible textured surfaces, 15 000 light points, 16 moving models.	Not applicable				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.
5. Sound System. The sponsor will not be required to repeat the airplane 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 airplane 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 airplane tests. If the airplane tests are repeated during continuing qualification evaluations, the results may be compared against initial qualification evaluation results or airplane 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 airplane data set. The airplane and flight simulator results must be produced using comparable data analysis techniques.								
5.a.	**Turbo-jet airplanes.**							All tests in this section should be presented using an unweighted 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 7 of Appendix A, Attachment 2.

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	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 must be on if appropriate.			**X**	
5.a.2.	All engines at idle.	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 takeoff.			**X**	
5.a.3.	All engines at maximum allowable thrust with brakes set.	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	Ground.	Normal condition prior to takeoff.			**X**	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		differences between initial and recurrent evaluation results cannot exceed 2 dB.						
5.a.4.	Climb	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.	En-route climb.	Medium altitude.			X	
5.a.5.	Cruise	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.	Cruise.	Normal cruise configuration.			X	
5.a.6.	Speed brake/spoilers extended (as appropriate).	Initial evaluation: Subjective assessment of 1/3 octave bands. Recurrent evaluation: cannot exceed ±5 dB difference on three	Cruise.	Normal and constant speed brake deflection for descent at a constant airspeed and power setting.			X	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.						
5.a.7	Initial approach.	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.	Approach.	Constant airspeed, gear up, flaps/slats as appropriate.			X	
5.a.8	Final approach.	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.	Landing.	Constant airspeed, gear down, landing configuration flaps.			X	

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Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
5.b	**Propeller-driven airplanes**							All tests in this section should be presented using an unweighted 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. Refer to paragraph 7 of Appendix A, Attachment 2.
5.b.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 must be on if appropriate.			X	
5.b.2	All propellers feathered, if applicable.	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	Ground.	Normal condition prior to take-off.			X	

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		initial and recurrent evaluation results cannot exceed 2 dB.						
5.b.3.	Ground idle or equivalent.	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 takeoff.			X	
5.b.4	Flight idle or equivalent.	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 takeoff.			X	
5.b.5	All engines at maximum allowable power with brakes set.	Initial evaluation: Subjective assessment of 1/3 octave bands. Recurrent evaluation: cannot exceed ±5 dB difference on three consecutive bands when	Ground.	Normal condition prior to takeoff.			X	

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.						
5.b.6	Climb.	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.	En-route climb.	Medium altitude.			X	
5.b.7	Cruise	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.	Cruise.	Normal cruise configuration.			X	
5.b.8	Initial approach.	Initial evaluation: Subjective assessment of 1/3 octave bands.	Approach.	Constant airspeed, gear up, flaps extended as appropriate, RPM as per operating manual.			X	

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
		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.						
5.b.9	Final approach.	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.	Landing.	Constant airspeed, gear down, landing configuration flaps, RPM as per operating manual.			X	
5.c.	**Special cases.**	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.	As appropriate.				X	This applies to special steady-state cases identified as particularly significant to the pilot, important in training, or unique to a specific airplane type or model.

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
5.d	**FSTD background noise**	Initial evaluation: background noise levels must fall below the sound levels described in Appendix A, Attachment 2, Paragraph 7.c (5). 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 NSPM. 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 7 of this Appendix A, Attachment 2. This test should be presented using an unweighted 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.					X	Only required if the results are to be used during continuing qualification evaluations in lieu of airplane tests. The results must be approved by the NSPM during the initial qualification. This test should be presented using an unweighted 1/3 octave band format from band 17 to 42 (50 Hz to 16 kHz).
6	**SYSTEMS INTEGRATION**							
6.a.	**System response time**							
6.a.1	Transport delay.	100 milliseconds or less after controller movement.	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,

Table B2A

Flight Training Device (FTD) Objective Tests								
QPS REQUIREMENTS								INFORMATION
Test		Tolerance	Flight Conditions	Test Details	FTD Level			Notes
Entry Number	Title				5	6	7	
								and not before motion system response. *Note.— The delay from the airplane EFVS electronic elements should be added to the 30 ms tolerance before comparison with visual system reference as described in Attachment G of this Part.*
6.a.2	Transport delay.	300 milliseconds or less after controller movement.	Pitch, roll and yaw.		**X**	**X**		

Begin Information

3. For Additional Information on the Following Topics, Please Refer to Appendix A, Attachment 2, and the Indicated Paragraph Within That Attachment

- Control Dynamics, paragraph 4.
- Motion System, paragraph 6.
- Sound System, paragraph 7.
- Engineering Simulator Validation Data, paragraph 9.
- Validation Test Tolerances, paragraph 11.
- Validation Data Road Map, paragraph 12.
- Acceptance Guidelines for Alternative Engines Data, paragraph 13.
- Acceptance Guidelines for Alternative Avionics, paragraph 14.
- Transport Delay Testing, paragraph 15.
- Continuing Qualification Evaluation Validation Data Presentation, paragraph 16.

End Information

4. Alternative Objective Data for FTD Level 5

Begin QPS Requirements

a. This paragraph (including the following tables) is relevant only to FTD Level 5. It is provided because this level is required to simulate the performance and handling characteristics of a set of airplanes with similar characteristics, such as normal airspeed/altitude operating envelope and the same number and type of propulsion systems (engines).

b. Tables B2B through B2E reflect FTD performance standards that are acceptable to the FAA. A sponsor must demonstrate that a device performs within these parameters, as applicable. If a device does not meet the established performance parameters for some or for all of the applicable tests listed in Tables B2B through B2E, the sponsor may use NSP accepted flight test data for comparison purposes for those tests.

c. Sponsors using the data from Tables B2B through B2E must comply with the following:

(1) 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 Tables B2B through B2E, as appropriate.

(2) 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.

(3) 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 B2A.

(4) 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.

End QPS Requirements

Begin Information

d. The reader is encouraged to consult the Airplane Flight Simulator Evaluation Handbook, Volumes I and II, published by the Royal Aeronautical Society, London, UK, and AC 25–7, Flight Test Guide for Certification of Transport Category Airplanes, and AC 23–8A, Flight Test Guide for Certification of Part 23 Airplanes, as amended, for references and examples regarding flight testing requirements and techniques.

End Information

Table B2B

Alternative Data Source for FTD Level 5		
Small, Single Engine (Reciprocating) Airplane		
QPS REQUIREMENT The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD.		
Applicable Test		**Authorized Performance Range**
Entry Number	**Title and Procedure**	
1.	**Performance.**	
1.c	**Climb.**	
1.c.1.	Normal climb with nominal gross weight, at best rate-of-climb airspeed.	Climb rate = 500 - 1200 fpm (2.5 - 6 m/sec).
1.f.	**Engines.**	
1.f.1.	Acceleration; idle to takeoff power.	2 - 4 Seconds.
1.f.2.	Deceleration; takeoff power to idle.	2 - 4 Seconds.
2.	**Handling Qualities.**	
2.c.	**Longitudinal Tests.**	
2.c.1.	Power change force.	
	a) Trim for straight and level flight at 80% 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.	5 - 15 lbs (2.2 - 6.6 daN) of force (Pull).
	OR	
	b) Trim for straight and level flight at 80% 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.	5 - 15 lbs (2.2 - 6.6 daN) of force (Push).
2.c.2.	Flap/slat change force.	
	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% of full flap travel. After stabilized, record stick force necessary to maintain original airspeed.	5 - 15 lbs (2.2 - 6.6 daN) of force (Pull).
	OR	
	b) Trim for straight and level flight with flaps extended to 50% 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 (Push).

Table B2B

Alternative Data Source for FTD Level 5 Small, Single Engine (Reciprocating) Airplane QPS REQUIREMENT The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD.		
Applicable Test		**Authorized Performance Range**
Entry Number	**Title and Procedure**	
2.c.4.	Gear change force.	
	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 (Pull).
	OR	
	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 (Push).
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.	
	a) Landing configuration.	40 - 60 knots; ± 5° of bank.
	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. May not reach ½ or double amplitude in less than 2 cycles.
2.d.	**Lateral Directional Tests.**	
2.d.2.	Roll response (rate). Roll rate must be measured through at least 30° of roll. Aileron control must be deflected 1/3 (33.3 percent) of maximum travel.	Must have a roll rate of 4° - 25°/second.
2.d.4.b.	Spiral stability. Cruise configuration and normal cruise airspeed. Establish a 20° - 30° bank. When stabilized, neutralize the aileron control and release. Must be completed in both directions of turn.	Initial bank angle (± 5°) after 20 seconds.
2.d.6.b.	Rudder response.	2° - 6° /second yaw rate.

Table B2B

Alternative Data Source for FTD Level 5		
Small, Single Engine (Reciprocating) Airplane		
QPS REQUIREMENT The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD.		
Applicable Test		**Authorized Performance Range**
Entry Number	**Title and Procedure**	
	Use 25 percent of maximum rudder deflection. (Applicable to approach or landing configuration.)	
2.d.7.	Dutch roll, yaw damper off. (Applicable to cruise and approach configurations.)	A period of 2 - 5 seconds; and ½ - 2 cycles.
2.d.8.	Steady state sideslip. Use 50 percent rudder deflection. (Applicable to approach and landing configurations.)	2° - 10° of bank; 4° - 10° of sideslip; and 2° -10° of aileron.
6.	FTD System Response Time.	
6.a.	Latency. Flight deck instrument systems response to an abrupt pilot controller input. One test is required in each axis (pitch, roll, yaw).	300 milliseconds or less.

Table B2C

Alternative Data Source for FTD Level 5 Small, Multi-Engine (Reciprocating) Airplane QPS REQUIREMENT The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD.		
Applicable Test		**Authorized Performance Range**
Entry Number	**Title and Procedure**	
1.	**Performance.**	
1.c	**Climb.**	
1.c.1.	Normal climb with nominal gross weight, at best rate-of-climb airspeed.	Climb airspeed = 95 – 115 knots. Climb rate = 500 – 1500 fpm (2.5 – 7.5 m/sec)
1.f.	**Engines.**	
1.f.1.	Acceleration; idle to takeoff power.	2 - 5 Seconds.
1.f.2.	Deceleration; takeoff power to idle.	2 - 5 Seconds.
2.	**Handling Qualities.**	
2.c.	**Longitudinal Tests.**	
2.c.1.	Power change force.	
	a) Trim for straight and level flight at 80% 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.	10 - 25 lbs (2.2 - 6.6 daN) of force (Pull).
	OR	
	b) Trim for straight and level flight at 80% 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.	5 - 15 lbs (2.2 - 6.6 daN) of force (Push).
2.c.2.	Flap/slat change force.	
	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% of full flap travel. After stabilized, record stick force necessary to maintain original airspeed.	5 - 15 lbs (2.2 - 6.6 daN) of force (Pull).

Table B2C

Alternative Data Source for FTD Level 5		
Small, Multi-Engine (Reciprocating) Airplane		
QPS REQUIREMENT The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD.		
Applicable Test		**Authorized Performance Range**
Entry Number	**Title and Procedure**	
	OR	
	b) Trim for straight and level flight with flaps extended to 50% 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 (Push).
2.c.4.	Gear change force.	
	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 (Pull).
	OR	
	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 (Push).
2.c.4.	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.	
	a) Landing configuration.	60 - 90 knots; ± 5° of bank.
	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. May not reach

Table B2C

Alternative Data Source for FTD Level 5		
Small, Multi-Engine (Reciprocating) Airplane		
QPS REQUIREMENT The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD.		
Applicable Test		**Authorized Performance Range**
Entry Number	**Title and Procedure**	
		½ or double amplitude in less than 2 cycles.
2.d.	**Lateral Directional Tests.**	
2.d.2.	Roll response. Roll rate must be measured through at least 30° of roll. Aileron control must be deflected 1/3 (33.3 percent) of maximum travel.	Must have a roll rate of 4° - 25° /second.
2.d.4.b.	Spiral stability. Cruise configuration and normal cruise airspeed. Establish a 20° - 30° bank. When stabilized, neutralize the aileron control and release. Must be completed in both directions of turn.	Initial bank angle (± 5°) after 20 seconds.
2.d.6.b.	Rudder response. Use 25 percent of maximum rudder deflection. (Applicable to approach or landing configuration.)	3° - 6° /second yaw rate.
2.d.7.	Dutch roll, yaw damper off. (Applicable to cruise and approach configurations.)	A period of 2 - 5 seconds; and ½ - 2 cycles.
2.d.8.	Steady state sideslip. Use 50 percent rudder deflection. (Applicable to approach and landing configurations.)	2° - 10° of bank; 4 - 10 degrees of sideslip; and 2° -10° 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, yaw).	300 milliseconds or less.

Table B2D

Alternative Data Source for FTD Level 5		
Small, Single Engine (Turbo-Propeller) Airplane		
QPS REQUIREMENT The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD.		
Applicable Test		**Authorized Performance Range**
Entry Number	**Title and Procedure**	
1.	**Performance.**	
1.c	**Climb.**	
1.c.1.	Normal climb with nominal gross weight, at best rate-of-climb airspeed.	Climb airspeed = 95 – 115 knots. Climb rate = 800 – 1800 fpm (4 - 9 m/sec)
1.f.	**Engines.**	
1.f.1.	Acceleration; idle to takeoff power.	4 - 8 Seconds.
1.f.2.	Deceleration; takeoff power to idle.	3 - 7 Seconds.
2.	**Handling Qualities.**	
2.c.	**Longitudinal Tests.**	
2.c.1.	Power change force.	
	a) Trim for straight and level flight at 80% 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.	8 lbs (3.5 daN) of Push force – 8 lbs (3.5 daN) of Pull force.
	OR	
	b) Trim for straight and level flight at 80% 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.	12 - 22 lbs (5.3 – 9.7 daN) of force (Push).
2.c.2.	Flap/slat change force.	
	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% of full flap travel. After stabilized, record stick force necessary to maintain original airspeed.	5 - 15 lbs (2.2 - 6.6 daN) of force (Pull).
	OR	

Table B2D

Alternative Data Source for FTD Level 5		
Small, Single Engine (Turbo-Propeller) Airplane		
QPS REQUIREMENT The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD.		
Applicable Test		**Authorized Performance Range**
Entry Number	**Title and Procedure**	
	b) Trim for straight and level flight with flaps extended to 50% 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 (Push).
2.c.4.	Gear change force.	
	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 (Pull).
	OR	
	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 (Push).
2.b.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.	
	a) Landing configuration.	60 - 90 knots; ± 5° of bank.
	b) Clean configuration.	Landing configuration speed + 10 - 20%.
2.c.8.b.	Phugoid dynamics.	Must have a phugoid with a period of 30 - 60 seconds. May not reach ½ or double amplitude in less than 2 cycles.
2.d.	**Lateral Directional Tests.**	
2.d.2.	Roll response. Roll rate must be measured through at least 30° of roll. Aileron control must be deflected 1/3 (33.3 percent) of maximum travel.	Must have a roll rate of 4° - 25° /second.
2.d.4.b.	Spiral stability.	Initial bank angle (± 5°) after 20 seconds.

Table B2D

Alternative Data Source for FTD Level 5 Small, Single Engine (Turbo-Propeller) Airplane QPS REQUIREMENT The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD.		
Applicable Test		**Authorized Performance Range**
Entry Number	**Title and Procedure**	
	Cruise configuration and normal cruise airspeed. Establish a 20° - 30° bank. When stabilized, neutralize the aileron control and release. Must be completed in both directions of turn.	
2.d.6.b.	Rudder response. Use 25 percent of maximum rudder deflection. (Applicable to approach or landing configuration.)	3° - 6° /second yaw rate.
2.d.7.	Dutch roll, yaw damper off. (Applicable to cruise and approach configurations.)	A period of 2 - 5 seconds; and ½ - 3 cycles.
2.d.8.	Steady state sideslip. Use 50 percent rudder deflection. (Applicable to approach and landing configurations.)	2° - 10° of bank; 4° - 10° of sideslip; and 2° -10° 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, yaw).	300 milliseconds or less.

Table B2E

Alternative Data Source for FTD Level 5 Multi-Engine (Turbo-Propeller) Airplane QPS REQUIREMENT The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD.		
Applicable Test		**Authorized Performance Range**
Entry Number	**Title and Procedure**	
1.	**Performance.**	
1.c	**Climb.**	
1.b.1.	Normal climb with nominal gross weight, at best rate-of-climb airspeed.	Climb airspeed = 120 – 140 knots. Climb rate = 1000 – 3000 fpm (5 - 15 m/sec)
1.f.	**Engines.**	
1.f.1.	Acceleration; idle to takeoff power.	2 - 6 Seconds.
1.f.2.	Deceleration; takeoff power to idle.	1 - 5 Seconds.
2.	**Handling Qualities.**	
2.c.	**Longitudinal Tests.**	
2.c.1.	Power change force.	
	a) Trim for straight and level flight at 80% 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.	8 lbs (3.5 daN) of Push force to 8 lbs (3.5 daN) of Pull force.
	OR	
	b) Trim for straight and level flight at 80% 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.	12 - 22 lbs (5.3 – 9.7 daN) of force (Push).
2.c.2.	Flap/slat change force.	
	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% of full flap travel. After stabilized, record stick force necessary to maintain original airspeed.	5 - 15 lbs (2.2 - 6.6 daN) of force (Pull).
	OR	
	b) Trim for straight and level flight with flaps extended to 50% 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 (Push).

Table B2E

Alternative Data Source for FTD Level 5		
Multi-Engine (Turbo-Propeller) Airplane		
QPS REQUIREMENT The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD.		
Applicable Test		**Authorized Performance Range**
Entry Number	**Title and Procedure**	
2.c.4.	Gear change force.	
	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 (Pull).
	OR	
	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 (Push).
2.b.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.	
	a) Landing configuration.	80 - 100 knots; ± 5° of bank.
	b) Clean configuration.	Landing configuration speed + 10 - 20%.
2.c.8.b.	Phugoid dynamics.	Must have a phugoid with a period of 30 - 60 seconds. May not reach ½ or double amplitude in less than 2 cycles.
2.d.	**Lateral Directional Tests.**	
2.d.2.	Roll response. Roll rate must be measured through at least 30° of roll. Aileron control must be deflected 1/3 (33.3 percent) of maximum travel.	Must have a roll rate of 4-25 degrees/second.
2.d.4.b.	Spiral stability. Cruise configuration and normal cruise airspeed. Establish a 20° - 30° bank. When stabilized, neutralize the aileron control and release. Must be completed in both directions of turn.	Initial bank angle (± 5°) after 20 seconds.
2.d.6.b.	Rudder response.	3° - 6° /second yaw rate.

Table B2E

Alternative Data Source for FTD Level 5 Multi-Engine (Turbo-Propeller) Airplane QPS REQUIREMENT The performance parameters in this table must be used to program the FTD if flight test data is not used to program the FTD.		
Applicable Test		**Authorized Performance Range**
Entry Number	**Title and Procedure**	
	Use 25 percent of maximum rudder deflection. (Applicable to approach or landing configuration.)	
2.d.7.	Dutch roll, yaw damper off. (Applicable to cruise and approach configurations.)	A period of 2 - 5 seconds; and ½ - 2 cycles.
2.d.8.	Steady state sideslip. Use 50 percent rudder deflection. (Applicable to approach and landing configurations.)	2° - 10° of bank; 4° - 10° of sideslip; and 2° -10° 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, yaw).	300 milliseconds or less.

End QPS Requirements

Begin QPS Requirements

5. Alternative Data Sources, Procedures, and Instrumentation: Level 6 FTD Only

a. 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 B2F.

End QPS Requirements

Begin Information

b. It has become standard practice for experienced FTD manufacturers to use such techniques as a means of establishing data bases for new FTD configurations while awaiting the availability of actual flight test data; and then comparing this new data with the newly available flight test data. The results of such comparisons have, as reported by some recognized and experienced simulation experts, become increasingly consistent and indicate that these techniques, applied with appropriate experience, are becoming dependably accurate for the development of aerodynamic models for use in Level 6 FTDs.

c. In reviewing this history, the NSPM has concluded that, with proper care, those who are experienced in the development of aerodynamic models for FTD application can successfully use these modeling techniques to acceptably alter the method by which flight test data may be acquired and, when applied to Level 6 FTDs, does not compromise the quality of that simulation.

d. The information in the table that follows (Table of Alternative Data Sources, Procedures, and Information: Level 6 FTD Only) is presented to describe an acceptable alternative to data sources for Level 6 FTD modeling and validation, and an acceptable alternative to the procedures and instrumentation found in the flight test methods traditionally accepted for gathering modeling and validation data.

(1) Alternative data sources that may be used for part or all of a data requirement are the Airplane Maintenance Manual, the Airplane Flight Manual (AFM), Airplane Design Data, the Type Inspection Report (TIR), Certification Data or acceptable supplemental flight test data.

(2) The NSPM recommends that use of the alternative instrumentation noted in Table B2F be coordinated with the NSPM prior to employment in a flight test or data gathering effort.

e. The NSPM position regarding the use of these alternative data sources, procedures, and instrumentation is based on three primary preconditions and presumptions regarding the objective data and FTD aerodynamic program modeling.

(1) 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 insures the collection of acceptable level, unaccelerated, 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, unaccelerated, and trimmed flight, and the results should be compared with the flight test pitch angle.

(2) 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.

f. Table B2F is not applicable to Computer Controlled Aircraft FTDs.

g. Utilization of these alternate data sources, procedures, and instrumentation does not relieve the sponsor from compliance with the balance of the information contained in this document relative to Level 6 FTDs.

h. The term ''inertial measurement system'' allows the use of a functional global positioning system (GPS).

End Information

TABLE B2F

Alternative Data Sources, Procedures, and Intrumentation Level 6 FTD		
QPS Requirements The standards in this table are required if the data gathering methods described in paragraph 9 of Appendix B are not used.		Information
Objective test reference No. and title	Alternative data sources, procedures, and instrumentation	Notes
1.b.1. Performance. Takeoff. Ground acceleration time.	Data may be acquired through a synchronized video recording of a stop watch and the calibrated airplane airspeed indicator. Hand-record the flight conditions and airplane configuration.	This test is required only if RTO is sought.
1.b.7. Performance. Takeoff. Rejected takeoff ..	Data may be acquired through a synchronized video recording of a stop watch and the calibrated airplane airspeed indicator. Hand-record the flight conditions and airplane configuration.	This test is required only if RTO is sought.
1.c.1. Performance. Climb. Normal climb all engines operating.	Data may be acquired with a synchronized video of calibrated airplane instruments and engine power throughout the climb range.	
1.f.1. Performance. Engines. Acceleration	Data may be acquired with a synchronized video recording of engine instruments and throttle position.	
1.f.2. Performance. Engines. Deceleration	Data may be acquired with a synchronized video recording of engine instruments and throttle position.	
2.a.1.a. Handling qualities. Static control tests. 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 NSPM, 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.

TABLE B2F—Continued

Alternative Data Sources, Procedures, and Intrumentation Level 6 FTD		
QPS Requirements The standards in this table are required if the data gathering methods described in paragraph 9 of Appendix B are not used.		Information
Objective test reference No. and title	Alternative data sources, procedures, and instrumentation	Notes
2.a.2.a. Handling qualities. Static control tests. Wheel 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 wheel positions (encompassing significant wheel position data points), acceptable to the NSPM, using a control surface protractor on the ground. Force data may be acquired by using a hand held force gauge at the same wheel position data points.	For airplanes with reversible control systems, surface position data acquisition should be accomplished with winds less than 5 kts.
2.a.3.a. Handling qualities. Static control tests. Rudder pedal 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 rudder pedal positions (encompassing significant rudder pedal position data points), acceptable to the NSPM, using a control surface protractor on the ground. Force data may be acquired by using a hand held force gauge at the same rudder pedal position data points.	For airplanes with reversible control systems, surface position data acquisition should be accomplished with winds less than 5 kts.
2.a.4. Handling qualities. 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. Handling qualities. Static control tests. 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. Handling qualities. Static control tests. Pitch trim indicator vs. surface position calibration.	Data may be acquired through calculations.	
2.a.8. Handling qualities. Static control tests. Alignment of power lever angle vs. selected engine parameter (e.g., EPR, N_1, 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. Handling qualities. Static control tests. 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.1. Handling qualities. Longitudinal control tests. Power change force.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated airplane instruments, throttle position, and the force/position measurements of flight deck controls.	Power change dynamics test is acceptable using the same data acquisition methodology.
2.c.2. Handling qualities. Longitudinal control tests. Flap/slat change force.	Data may be acquired by using an inertial measurement system and a synchronized video of calibrated airplane 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. Handling qualities. Longitudinal control tests. Gear change force.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated airplane 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. Handling qualities. Longitudinal control tests. 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.	

TABLE B2F—Continued

Alternative Data Sources, Procedures, and Intrumentation Level 6 FTD		
QPS Requirements The standards in this table are required if the data gathering methods described in paragraph 9 of Appendix B are not used.		Information
Objective test reference No. and title	Alternative data sources, procedures, and instrumentation	Notes
2.c.6. Handling qualities. Longitudinal control tests. 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 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. Handling qualities. Longitudinal control tests. Longitudinal static stability.	Data may be acquired through the use of a synchronized video of the airplane flight instruments and a hand held force gauge.	
2.c.8. Handling qualities. Longitudinal control tests. Stall Warning (activation of stall warning device).	Data may be acquired through a synchronized video recording of a stop watch and the 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.a. Handling qualities. Longitudinal control tests. Phugoid dynamics.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated airplane instruments and the force/position measurements of flight deck controls.	
2.c.10. Handling qualities. Longitudinal control tests. Short period dynamics.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated airplane instruments and the force/position measurements of flight deck controls.	
2.c.11. Handling qualities. Longitudinal control tests. Gear and flap/slat operating times.	May use design data, production flight test schedule, or maintenance specification, together with an SOC.	
2.d.2. Handling qualities. Lateral directional tests. Roll response (rate).	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated airplane instruments and the force/position measurements of flight deck lateral controls.	
2.d.3. Handling qualities. Lateral directional tests. (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 airplane instruments and the force/position measurements of flight deck lateral controls.	
2.d.4. Handling qualities. Lateral directional tests. Spiral stability.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated airplane instruments; the force/position measurements of flight deck controls; and a stop watch.	
2.d.6.a. Handling qualities. Lateral directional tests. Rudder response.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated airplane instruments; the force/position measurements of rudder pedals.	
2.d.7. Handling qualities. Lateral directional tests. Dutch roll, (yaw damper OFF).	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated airplane instruments and the force/position measurements of flight deck controls.	
2.d.8. Handling qualities. Lateral directional tests. Steady state sideslip.	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated airplane instruments and the force/position measurements of flight deck controls.	

Attachment 3 to Appendix B to Part 60—Flight Training Device (FTD) Subjective Evaluation

Begin Information

1. Discussion

a. The subjective tests provide a basis for evaluating the capability of the FTD to perform over a typical utilization period. The items listed in the Table of Functions and Subjective Tests are used to determine whether the FTD competently simulates each required maneuver, procedure, or task; and verifying correct operation of the FTD controls, instruments, and systems. The tasks do not limit or exceed the authorizations for use of a given level of FTD as described on the SOQ or as approved by the TPAA. All items in the following paragraphs are subject to examination.

b. All simulated airplane systems functions will be assessed for normal and, where appropriate, alternate operations. Simulated airplane 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 NSP pilot will include in his report to the TPAA, the effect of the system operation and any system limitation.

c. At the request of the TPAA, the NSP Pilot may assess the FTD for a special aspect of a sponsor's training program during the functions and subjective portion of an evaluation. Such an assessment may include a portion of a specific operation (e.g., a Line Oriented Flight Training (LOFT) scenario) or special emphasis items in the sponsor's training program. Unless directly related to a requirement for the qualification level, the results of such an evaluation would not affect the qualification of the FTD.

End Information

Table B3A

Functions And Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Operations Tasks	FTD Level			
		4	5	6	7
	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 (where installed for Level 5 FTD) 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 simulated.			X	X
1.a.2	The flight deck (or flight deck area) design and functions replicate the appropriate airplane.		X		
1.a.3	Reserved				
2.	**Surface Operations (pre-flight).**				
2.a.	**Engine Start. (if installed for Level 5 FTD)**				
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 (powerback requires visual system)			X	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
2.d	**Other**				X
3.	**Take-off.**				
3.a.	**Normal.**				
3.a.1.	Airplane/engine parameter relationships, including run-up.			X	X
3.a.2.	Nosewheel and rudder steering.			X	X
3.a.3.	Crosswind (maximum demonstrated and gusting crosswind).				X
3.a.4.	Special performance				
3.a.4.a	Reduced V_1				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

Table B3A

Functions And Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Operations Tasks	FTD Level			
		4	5	6	7
3.a.7.	Contaminated runway operation.				X
3.b.	Abnormal/emergency.				
3.b.1.	Rejected Take-off.			X	X
3.b.2.	Rejected special performance (e.g., reduced V_1, 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). (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)**				
5.a.1.	Straight and level flight.		X	X	X
5.a.2.	Change of airspeed.		X	X	X
5.a.3.	High altitude handling.			X	X
5.a.4.	High Mach number handling (Mach tuck, Mach buffet) and recovery (trim change).			X	X
5.a.5.	Overspeed warning (in excess of V_{mo} or M_{mo}).			X	X
5.a.6.	High IAS handling.			X	X
5.b.	**Maneuvers.**				
5.b.1.	High angle of attack, approach to stalls, and stall warning (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.	Reserved				X
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).			X	X
5.b.10.	Maneuvering with one or more engines inoperative, as appropriate.				X
5.b.11.	Specific flight characteristics (e.g., direct lift control).			X	X

Table B3A

Functions And Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Operations Tasks	FTD Level			
		4	5	6	7
5.b.12.	Flight control system failures, reconfiguration modes, manual reversion and associated handling.			X	X
5.b.13	Gliding to a forced landing.				X
5.b.14	Visual resolution and FSTD handling and performance for the following:				
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.				X
5.b.14.e	S-turns about a road or section line.				X
5.b.15	Reserved				
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	X
7.	**Instrument Approaches And Landing.** 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 5 and Level 6 FTDs are not authorized to credit the landing maneuver. For Level 5 FTD, approaches are evaluated as applicable for the systems installed.				
7.a.	**Precision approach (Approach only for Level 5 and Level 6 FTDs)**				
7.a.1	CAT I published approaches.				
7.a.1.a	Manual approach with/without flight director including landing.		X	X	X
7.a.1.b	Autopilot/autothrottle coupled approach and manual landing.		X	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 autoland).		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
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 autoland).				X

Table B3A

Functions And Subjective Tests QPS REQUIREMENTS					
Entry Number	Operations Tasks	FTD Level			
		4	5	6	7
7.a.3.b	Autopilot/autothrottle coupled approach to DH and go-around (manual and autopilot).		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
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 (to a landing or to a go-around):				
7.a.4.a	With generator failure.			X	X
7.a.4.b	With maximum tail wind component certified or authorized.			X	X
7.a.4.c	With maximum crosswind component demonstrated or authorized.			X	X
7.a.5	PAR approach, all engine(s) operating and with one or more engine(s) inoperative. (engine inoperative required only for Level 7 FTD)		X	X	X
7.a.6	MLS, GBAS, all engine(s) operating and with one or more engine(s) inoperative. (engine inoperative required only for Level 7 FTD)		X	X	X
7.b.	**Non-precision approach (Engine inoperative required only for Level 7 FTD)**				
7.b.1	Surveillance radar approach, all engine(s) operating and with one or more engine(s) inoperative.		X	X	X
7.b.2	NDB approach, all engine(s) operating and with one or more engine(s) inoperative.		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
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
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
7.b.6	ILS offset localizer approach, all engine(s) operating and with one or more engine(s) inoperative.		X	X	X
7.c	**Approach procedures with vertical guidance (APV), e.g. SBAS, flight path vector (Engine inoperative required only for Level 7 FTD)**				
7.c.1	APV/baro-VNAV approach, all engine(s) operating and with one or more engine(s) inoperative.		X	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	X
8.	**Visual Approaches (Visual Segment) And Landings.**				

Table B3A

Functions And Subjective Tests						
QPS REQUIREMENTS						
Entry Number	Operations Tasks	FTD Level				
		4	5	6	7	
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.	Approach and landing with crosswind (max. demonstrated and 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.**					
9.a.	All engines, manual and autopilot.			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				X	
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	Brake and anti-skid operation with dry and wet conditions.					
10.a.6.c	Brake and anti-skid operation with dry conditions.					
10.a.6.d	Auto-braking system operation.				X	
10.b	**Engine shutdown and parking.**					

Table B3A

Functions And Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Operations Tasks	FTD Level			
		4	5	6	7
10.b.1	Engine and systems operation.			X	X
10.b.2	Parking brake operation.			X	X
11.	**Any Flight Phase.**				
11.a.	**Airplane and engine systems operation (where fitted). For Level 5 FTD, airplane and engine system operation is evaluated as applicable for the systems installed.**				
11.a.1.	Air conditioning and pressurization (ECS).		X	X	X
11.a.2.	De-icing/anti-icing.		X	X	X
11.a.3.	Auxiliary power unit (APU).		X	X	X
11.a.4.	Communications.		X	X	X
11.a.5.	Electrical.		X	X	X
11.a.6.	Fire and smoke detection and suppression.		X	X	X
11.a.7.	Flight controls (primary and secondary).		X	X	X
11.a.8.	Fuel and oil		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
11.a.12.	Oxygen.		X	X	X
11.a.13.	Engine.		X	X	X
11.a.14.	Airborne radar.				X
11.a.15.	Autopilot and Flight Director.		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	X
11.a.18.	Flight display systems.		X	X	X
11.a.19.	Flight management computers.		X	X	X
11.a.20.	Head-up displays (including EFVS, if appropriate).				X
11.a.21.	Navigation systems		X	X	X
11.a.22.	Stall warning/avoidance		X	X	X
11.a.23.	Wind shear avoidance/recovery guidance equipment				X
11.a.24.	Flight envelope protections		X	X	X
11.a.25.	Electronic flight bag		X	X	X
11.a.26.	Automatic checklists (normal, abnormal and emergency procedures).		X	X	X
11.a.27.	Runway alerting and advisory system.				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 (where qualified)				X
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

Table B3A

Functions And Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Operations Tasks	FTD Level			
		4	5	6	7
11.b.3.d	On final approach, below 150 m (500 ft) AGL.				X
11.b.4.	Effects of airframe ice.			X	X
12.	Level 4 FTDs are required to have at least one operational system. The NSPM will accomplish a functions check of all installed systems, switches, indicators, and equipment at all crewmembers' and instructors' stations, and determine that the flight deck (or flight deck area) design and functions replicate the appropriate airplane.	X			

End QPS Requirements

Table B3B

Functions And Subjective Tests		
QPS REQUIREMENTS		
Entry Number	For Qualification at Level 7 FTD Class I Airport Models	

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 FTD qualification.	
Begin QPS Requirements	
1.	**Reserved**
2.a.	**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. Not all of the elements described in this section must be found in a single airport model. 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	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 attachment 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.
2.a.2	**Visual scene fidelity.**
2.a.2.a	The visual scene should correctly represent the parts of the airport and its surroundings used in the training program.
2.a.2.b	Reserved
2.a.2.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 should be modeled to provide correlation with airplane systems (e.g. HUD, GPS, compass, altimeter).
2.a.6	Reserved

Table B3B

Functions And Subjective Tests		
QPS REQUIREMENTS		
Entry Number	For Qualification at Level 7 FTD Class I Airport Models	

2.a.7	**Runway surface and markings for each "in-use" runway should 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.
2.a.7.g	Reserved
2.a.7.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.9.e	Reserved
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 should be properly aligned with the navigational aids that are associated with operations at the runway "in-use".
2.a.11.b	Reserved
2.a.12	**Airport buildings, structures and lighting.**
2.a.12.a	Buildings, structures and lighting:
2.a.12.a.	Reserved
2.a.12.a.	Representative airport buildings, structures and lighting.
2.a.12.a.	Reserved
2.a.12.b	Reserved

Table B3B

Functions And Subjective Tests		
QPS REQUIREMENTS		
Entry Number	For Qualification at Level 7 FTD Class I Airport Models	

2.a.12.c	Representative moving and static gate clutter (e.g. other airplanes, power carts, tugs, fuel trucks, additional gates).
2.a.12.d	Reserved
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.**
2.a.14.a	Reserved
2.a.14.b	Representative depiction of significant and identifiable natural and cultural features within 46 km (25 NM) of the reference airport. *Note.— This refers to natural and cultural features that are typically used for pilot orientation in flight. Outlying airports not intended for landing need only provide a reasonable facsimile of runway orientation.*
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 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.
2.b.3	Reserved
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.
2.c.2	**Visual approach aids lights.**
2.c.2.a	Reserved
2.c.2.b	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 should 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.

Table B3B

Functions And Subjective Tests		
QPS REQUIREMENTS		
Entry Number	For Qualification at Level 7 FTD Class I Airport Models	

2.d.5	Reserved
2.e	**Correlation with airplane and associated equipment.**
2.e.1	Visual cues to relate to actual airplane responses.
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.
2.e.2.b	Reserved
2.e.3	Accurate portrayal of environment relating to airplane attitudes.
2.e.4	The visual scene should correlate with integrated airplane systems, where fitted (e.g. terrain, traffic and weather avoidance systems and HUD/EFVS).
2.e.5	Reserved
2.f	**Scene quality.**
2.f.1	**Quantization.**
2.f.1.a	Surfaces and textural cues should be free from apparent quantization (aliasing).
2.f.1.b	Reserved
2.f.2	System capable of portraying full color realistic textural cues.
2.f.3	The system light points should be free from distracting jitter, smearing or streaking.
2.f.4	Reserved
2.f.5	System capable of providing light point perspective growth.
2.g	**Environmental effects.**
2.g.1	Reserved
2.g.2	Reserved
2.g.3	Reserved
2.g.4	Reserved
2.g.5	Reserved
2.g.6	Reserved
2.g.7	Visibility and RVR measured in terms of distance. Visibility/RVR should be checked at and below a height of 600 m (2 000 ft) above the airport and within a radius of 16 km (10 sm) from the airport.
2.g.8	Reserved
2.g.9	Reserved
2.g.10	Reserved
2.g.11	Reserved
	End QPS Requirement

	Begin Information
3.	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

Table B3B

Functions And Subjective Tests		
QPS REQUIREMENTS		
Entry Number	**For Qualification at Level 7 FTD** **Class I Airport Models**	
	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, does not cause changes in navigational radio frequencies, and does not cause undue instructor/evaluator time.	
4.	Sponsors are not required to provide every detail of a runway, but the detail that is provided should be correct within the capabilities of the system. **End Information**	

Table B3C

Functions and Subjective Tests					
QPS REQUIREMENTS					
Entry Number	**Sound System**	**FTD Level**			
		4	**5**	**6**	**7**
The following checks are performed during a normal flight profile.					
1.	Precipitation.				**X**
2.	Reserved				
3.	Significant airplane noises perceptible to the pilot during normal operations.			**X**	**X**
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.				**X**
5.	Sound of a crash when the flight simulator is landed in excess of limitations.				**X**

Table B3D

Functions and Subjective Tests					
QPS REQUIREMENTS					
Entry Number	Special Effects	FTD Level			
		4	5	6	7
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 airplane), including antiskid and decreased brake efficiency due to high brake temperatures (based on airplane related data), sufficient to enable pilot identification of the problem and implementation of appropriate procedures.				X
2.	**Effects of Airframe and Engine Icing:** **Required only for those airplanes 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. Activate heating, anti-ice, or de-ice systems independently. Recognition will include proper effects of these systems, eventually returning the simulated airplane to normal flight.				X

Table B3E

Functions and Subjective Tests QPS REQUIREMENTS					
Entry Number	Instructor Operating Station (IOS) (As appropriate)	FTD Level			
		4	5	6	7
	Functions in this table are subject to evaluation only if appropriate for the airplane and/or the system is installed on the specific simulator.				
1.	**Simulator Power Switch(es)**		X	X	X
2.	**Airplane conditions.**				
2.a.	Gross weight, center of gravity, fuel loading and allocation			X	X
2.b.	Airplane systems status.			X	X
2.c.	Ground crew functions (e.g., ext. power, push back)			X	X
3.	**Airports.**				
3.a.	Number and selection.			X	X
3.b.	Runway selection.			X	X
3.c.	Runway surface condition (e.g., rough, smooth, icy, wet)			X	X
3.d.	Preset positions (e.g., ramp, gate, #1 for takeoff, takeoff position, over FAF)		X	X	X
3.e.	Lighting controls.				X
4.	**Environmental controls.**				
4.a	Visibility (statute miles (kilometers)).				X
4.b.	Runway visual range (in feet (meters)).				X
4.c.	Temperature.			X	X
4.d.	Climate conditions (e.g., ice, snow, rain).			X	X
4.e.	Wind speed and direction.			X	X
4.f.	Windshear.				X
4.g.	Clouds (base and tops).				X
5.	**Airplane system malfunctions** (Inserting and deleting malfunctions into the simulator).		X	X	X
6.	**Locks, Freezes, and Repositioning.**				
6.a.	Problem (all) freeze / release.			X	X
6.b.	Position (geographic) freeze / release.			X	X
6.c.	Repositioning (locations, freezes, and releases).			X	X
6.d.	Ground speed control.			X	X
7.	Remote IOS. (if installed)			X	X
8.	**Sound Controls.** On / off / adjustment			X	X
9.	**Control Loading System.**				
9.a.	**On / off / emergency stop.**			X	X
10.	**Observer Seats / Stations.** Position / Adjustment			X	X

Attachment 4 to Appendix B to Part 60—Sample Documents

Begin Information

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Title of Sample

Figure B4A—Sample Letter, Request for Initial, Upgrade, or Reinstatement Evaluation.
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Figure B4C—Sample Letter of Compliance
Figure B4D—Sample Qualification Test Guide Cover Page
Figure B4E—Sample Statement of Qualification—Certificate
Figure B4F—Sample Statement of Qualification—Configuration List
Figure B4G—Sample Statement of Qualification—List of Qualified Tasks
Figure B4H—Sample Continuing Qualification Evaluation Requirements Page
Figure B4I—Sample MQTG Index of Effective FTD Directives

Attachment 4 to Appendix B to Part 60—
Figure B4A – Sample Letter, Request for Initial, Upgrade, or Reinstatement Evaluation.
INFORMATION

Date _____

Edward D. Cook, Ph.D.
Manager, National Simulator Program
Federal Aviation Administration
100 Hartsfield Centre Parkway. Suite 400
Atlanta, GA 30354

Dear Dr. Cook:

RE: Request for Initial/Upgrade Evaluation Date

This is to advise you of our intent to request an (initial or upgrade) evaluation of our (FTD Manufacturer), (Aircraft Type/Level) Flight Training Device (FTD), (FAA ID Number, if previously qualified), located in (City, State) at the (Facility) on (Proposed Evaluation Date). (The proposed evaluation date shall not be more than 180 days following the date of this letter.) The FTD will be sponsored by (Name of Training Center/Air Carrier), FAA Designator (4 Letter Code). The FTD will be sponsored as follows; (Select One)

☐ The FTD will be used within the sponsor's FAA approved training program and placed on the sponsor's Training/Operations Specifications.

☐ The FTD will be used for dry lease only.

We agree to provide the formal request for the evaluation to your staff as follows: (check one)

☐ For QTG tests run at the factory, not later, than 45 days prior to the proposed evaluation date with the additional "l/3 on-site" tests provided not later than 14 days prior to the proposed evaluation date.

☐ For QTG tests run on-site, not later than 30 days prior to the proposed evaluation date.

We understand that the formal request will contain the following documents:

4. Sponsor's Letter of Request (*Company Compliance Letter*).
5. Principal Operations Inspector (POI) or Training Center Program Manager's (TCPM) endorsement.
6. Complete QTG.

If we are unable to meet the above requirements, we understand this may result in a significant delay, perhaps 45 days or more, in rescheduling and completing the evaluation.

(The sponsor should add additional comments as necessary).

Please contact (Name Telephone and Fax Number of Sponsor's Contact) to confirm the date for this initial evaluation. We understand a member of your National Simulator Program staff will respond to this request within 14 days.

A copy of this letter of intent has been provided to (Name), the Principal Operations Inspector (POI) and/or Training Center Program Manager (TCPM).

Sincerely,

Attachment: FTD Information and Characteristics Form
cc: POI/TCPM

Attachment 4 to Appendix B to Part 60—
Figure B4B – Sample Letter , Request for Initial, Upgrade, or Reinstatement Evaluation
Attachment: FSTD Information Form
INFORMATION

Date: ____			
Section 1. FSTD Information and Characteristics			
Sponsor Name:	____	**FSTD Location:**	
Address:	____ ____	**Physical Address:**	____ ____
City:	____	**City:**	____
State:	____	**State:**	____
Country:	____	**Country:**	____
ZIP:	____	**ZIP:**	____
Manager	____		
Sponsor ID No: (Four Letter FAA Designator)	____	**Nearest Airport:** (Airport Designator)	____
Type of Evaluation Requested:	☐ **Initial** ☐ **Upgrade** ☐ **Continuing Qualification** ☐ **Special** ☐ **Reinstatement**		
Aircraft Make/model/series:	____		
Initial Qualification: (If Applicable)	**Date:** ____ **Level** ____ MM/DD/YYYY	**Manufacturer's Identification or Serial Number**	____
Upgrade Qualification: (If Applicable)	**Date:** ____ **Level** ____ MM/DD/YYYY	☐ **eMQTG**	
Qualification Basis: ____	☐ **A** ☐ **6**	☐ **B** ☐ **7**	☐ **Interim C** ☐ **Provisional Status** ☐ **C** ☐ **D**
Other Technical Information:			
FAA FSTD ID No: (If Applicable)	____	**FSTD Manufacturer:**	____
Convertible FSTD:	☐ **Yes:**	**Date of Manufacture:**	____ MM/DD/YYYY
Related FAA ID No. (If Applicable)	____ ____ ____	**Sponsor FSTD ID No:** ____	
Engine model(s) and data revision: ____		**Source of aerodynamic model:** ____	
FMS identification and revision level: ____		**Source of aerodynamic coefficient data:** ____	
Visual system manufacturer/model: ____		**Aerodynamic data revision number:** ____	
Flight control data revision: ____		**Visual system display:** ____	
Mot ion system manufacturer/type: ____		**FSTD computer(s) identification:** ____	
National Aviation Authority (NAA): (If Applicable)	____		
NAA FSTD ID No:	____	**Last NAA Evaluation Date:**	____
NAA Qualification Level:	____		
NAA Qualification Basis:	____		
Visual System Manufacturer and Type:	____	**FSTD Seats Available:** ____ ____	**Motion System Manufacturer and Type:** ____ :

Attachment 4 to Appendix B to Part 60—
Figure B4B – Sample Letter , Request for Initial, Upgrade, or Reinstatement Evaluation
Attachment: FSTD Information Form
INFORMATION

Aircraft Equipment:	Engine Type(s):	Flight Instrumentation:	Engine Instrumentation:
	____ ____	☐ EFIS ☐ HUD ☐ HGS ☐ EFVS ☐ TCAS ☐ GPWS ☐ Plain View ☐ GPS ☐ FMS Type: ___ ☐ WX Radar ☐ Other: ___	☐ EICAS ☐ FADEC ☐ Other: ___

Airport Models:	3.6.1 _____ Airport Designator	3.6.2_____ Airport Designator	3.6.3 _____ Airport Designator
Circle to Land:	3. 7.1 _____ Airport Designator	3. 7.2_____ Approach	3. 7.3 _____ Landing Runway
Visual Ground Segment	3.8.1 _____ Airport Designator	3.8 .2_____ Approach	3. 8.3 _____ Landing Runway

Section 2. Supplementary Information			
FAA Training Program Approval Authority:		☐ POI ☐ TCPM ☐ Other:	
Name:	_____	**Office:**	_____
Tel:	_____	**Fax:**	_____
Email:	_____		
FSTD Scheduling Person:			
Name:	_____		
Address 1:	_____	**Address 2**	_____
City:	_____	**State:**	_____
ZIP:	_____	**Email:**	_____
Tel:	_____	**Fax:**	_____
FSTD Technical Contact:			
Name:	_____		
Address 1:	_____	**Address 2**	_____
City:	_____	**State:**	_____
ZIP:	_____	**Email:**	_____
Tel:	_____	**Fax:**	_____

Section 3. Training, Testing and Checking Considerations		
Area/Function/Maneuver	**Requested**	**Remarks**
Private Pilot - Training / Checks: (142)	☐	_____
Commercial Pilot - Training /Checks:(142)	☐	_____
Multi-Engine Rating - Training / Checks (142)	☐	_____
Instrument Rating -Training / Checks (142)	☐	_____
Type Rating - Training / Checks (135/121/142)	☐	_____
Proficiency Checks (135/121/142)	☐	_____

Attachment 4 to Appendix B to Part 60—
Figure B4B – Sample Letter , Request for Initial, Upgrade, or Reinstatement Evaluation
Attachment: FSTD Information Form
INFORMATION

CAT I: (RVR 2400/1800 ft. DH200 ft)	☐	_____
CAT II: (RVR 1200 ft. DH 100 ft)	☐	_____
CAT III * (lowest minimum) _____ RVR _____ ft. * State CAT III (≤ 700 ft.), CAT IIIb (≤ 150 ft.), or CAT IIIc (0 ft.)	☐	_____
Circling Approach	☐	_____
Windshear Training:	☐	_____
Windshear Training IAW 121.409(d) (121 Turbojets Only)	☐	_____
Generic Unusual Attitudes and Recoveries within the Normal Flight Envelope	☐	_____
Specific Unusual Attitudes Recoveries	☐	_____
Auto-coupled Approach/Auto Go Around	☐	_____
Auto-land / Roll Out Guidance	☐	_____
TCAS/ACAS I / II	☐	_____
WX-Radar	☐	_____
HUD	☐	_____
HGS	☐	_____
EFVS	☐	_____
Future Air Navigation Systems	☐	_____
GPWS / EGPWS	☐	_____
ETOPS Capability	☐	_____
GPS	☐	_____
SMGCS	☐	_____
Helicopter Slope Landings	☐	_____
Helicopter External Load Operations	☐	_____
Helicopter Pinnacle Approach to Landings	☐	_____
Helicopter Night Vision Maneuvers	☐	_____
Helicopter Category A Takeoffs	☐	_____

Attachment 4 to Appendix B to Part 60—
Figure B4C – Sample Letter of Compliance
INFORMATION

(Date)

Mr. (Name of Training Program Approval Authority):
(Name of FAA FSDO)
(Address)
(City/State/Zip)

Dear Mr. (Name of TPAA):

RE: Letter of Compliance

(Operator Sponsor Name) requests evaluation of our (Aircraft Type) FTD for Level (__) qualification. The (FTD Manufacturer Name) FTD with (Visual System Manufacturer Name/Model) system is fully defined on the FTD Information page of the accompanying Qualification Test Guide (QTG). We have completed the tests of the FTD and certify that it meets all applicable requirements of FAR parts 121, 125, or 135), and the guidance of (AC 120-40B or 14 CFR Part 60). Appropriate hardware and software configuration control procedures have been established. Our Pilot(s), (Name(s)), who are qualified on (Aircraft Type) aircraft have assessed the FTD and have found that it conforms to the (Operator/Sponsor) (Aircraft Type) flight deck configuration and that the simulated systems and subsystems function equivalently to those in the aircraft. The above named pilot(s) have also assessed the performance and the flying qualities of the FTD and find that it represents the respective aircraft.

(Added Comments may be placed here)

Sincerely,
(Sponsor Representative)

cc:
FAA, National Simulator Program

Attachment 4 to Appendix B to Part 60—
Figure B4D – Sample Qualification Test Guide Cover Page
INFORMATION

SPONSOR NAME

SPONSOR ADDRESS

FAA QUALIFICATION TEST GUIDE

(SPECIFIC AIRPLANE MODEL)
for example
Stratos BA797-320A

(Type of FTD)

(FTD Identification Including Manufacturer, Serial Number, Visual System Used)

(FTD Level)

(Qualification Performance Standard Used)

(FTD Location)

FAA Initial Evaluation

Date: _____

_____ Date: _____
(Sponsor)

_____ Date: _____
Manager, National
Simulator Program, FAA

Attachment 4 to Appendix B to Part 60—
Figure B4E – Sample Statement of Qualification - Certificate
INFORMATION

Federal Aviation Administration
National Simulator Program

Certificate of Qualification

This is to certify that representatives of the National Simulator Program Completed an evaluation of the

Go-Fast Airlines
Farnsworth Z-100 Flight Training Device

FAA Identification Number 998

And pursuant to 14 CFR Part 60 found it to meet its original qualification basis, AC 120-45A (MM/DD/YY)

The Master Qualification Test Guide and the attached Configuration List and Restrictions List Provide the Qualification Basis for this device to operate at

Level 6

Until March 31, 2010

Unless sooner rescinded or extended by the National Simulator Program Manager

February 15, *2009* (date)

B. Williamson (for the NSPM)

Attachment 4 to Appendix B to Part 60—
Figure B4F – Sample Statement of Qualification; Configuration List
INFORMATION

CERTIFICATE OF QUALIFICATION
CONFIGURATION LIST

Date: _____			
Section 1. FSTD Information and Characteristics			
Sponsor Name:	_____	**FSTD Location:**	
Address:	_____ _____	**Physical Address:**	_____ _____
City:	_____	**City:**	_____
State:	_____	**State:**	_____
Country:	_____	**Country:**	_____
ZIP:	_____	**ZIP:**	_____
Manager	_____		
Sponsor ID No: (Four Letter FAA Designator)	_____	**Nearest Airport:** (Airport Designator)	_____
Type of Evaluation Requested:	☐ **Initial** ☐ **Upgrade** ☐ **Continuing Qualification** ☐ **Special** ☐ **Reinstatement**		
Aircraft Make/model/series:	_____		
Initial Qualification: (If Applicable)	**Date:** _____ **Level** _____ MM/DD/YYYY	**Manufacturer's Identification or Serial Number**	_____
Upgrade Qualification: (If Applicable)	**Date:** _____ **Level** _____ MM/DD/YYYY	☐ **eMQTG**	
Qualification Basis:_____	☐ **A** ☐ **B** ☐ **Interim C** ☐ **C** ☐ **D** ☐ **6** ☐ **7** ☐ **Provisional Status**		
Other Technical Information:			
FAA FSTD ID No: (If Applicable)	_____	**FSTD Manufacturer:**	_____
Convertible FSTD:	☐ **Yes:**	**Date of Manufacture:**	_____ MM/DD/YYYY
Related FAA ID No. (If Applicable)	_____ _____ _____	**Sponsor FSTD ID No:**	_____
Engine model(s) and data revision: _____		**Source of aerodynamic model:** _____	
FMS identification and revision level: _____		**Source of aerodynamic coefficient data:** _____	
Visual system manufacturer/model: _____		**Aerodynamic data revision number:** _____	
Flight control data revision: _____		**Visual system display:** _____	
Mot ion system manufacturer/type: _____		**FSTD computer(s) identification:** _____	
National Aviation Authority (NAA): (If Applicable)	_____		
NAA FSTD ID No:	_____	**Last NAA Evaluation Date:**	_____
NAA Qualification Level:	_____		
NAA Qualification Basis:	_____		

Attachment 4 to Appendix B to Part 60—
Figure B4F – Sample Statement of Qualification; Configuration List

INFORMATION

Visual System Manufacturer and Type:	_____	**FSTD Seats Available:** ___	**Motion System Manufacturer and Type:**	_____:

Aircraft Equipment:	**Engine Type(s):** ____ ____	**Flight Instrumentation:** ☐ EFIS ☐ HUD ☐ HGS ☐ EFVS ☐ TCAS ☐ GPWS ☐ Plain View ☐ GPS ☐ FMS Type: ___ ☐ WX Radar ☐ Other: ___	**Engine Instrumentation:** ☐ EICAS ☐ FADEC ☐ Other: ___

Airport Models:	3.6.1 _____ Airport Designator	3.6.2_____ Airport Designator	3.6.3 _____ Airport Designator
Circle to Land:	3. 7.1 _____ Airport Designator	3. 7.2_____ Approach	3. 7.3 _____ Landing Runway
Visual Ground Segment	3.8.1 _____ Airport Designator	3.8 .2_____ Approach	3. 8.3 _____ Landing Runway

Section 2. Supplementary Information

FAA Training Program Approval Authority:		☐ **POI** ☐ **TCPM** ☐ **Other**: _____	
Name:	_____	**Office:**	_____
Tel:	_____	**Fax:**	_____
Email:	_____		

FSTD Scheduling Person:			
Name:	_____		
Address 1:	_____	**Address 2**	_____
City:	_____	**State:**	_____
ZIP:	_____	**Email:**	_____
Tel:	_____	**Fax:**	_____

FSTD Technical Contact:			
Name:	_____		
Address 1:	_____	**Address 2**	_____
City:	_____	**State:**	_____
ZIP:	_____	**Email:**	_____
Tel:	_____	**Fax:**	_____

Section 3. Training, Testing and Checking Considerations

Area/Function/Maneuver	Requested	Remarks
Private Pilot - Training / Checks: (142)	☐	_____
Commercial Pilot - Training /Checks:(142)	☐	_____
Multi-Engine Rating - Training / Checks (142)	☐	_____

Attachment 4 to Appendix B to Part 60—
Figure B4F – Sample Statement of Qualification; Configuration List

INFORMATION

Instrument Rating -Training / Checks (142)	☐	_____
Type Rating - Training / Checks (135/121/142)	☐	_____
Proficiency Checks (135/121/142)	☐	_____
CAT I: (RVR 2400/1800 ft. DH200 ft)	☐	_____
CAT II: (RVR 1200 ft. DH 100 ft)	☐	_____
CAT III * (lowest minimum) _____ RVR _____ ft. * State CAT III (≤ 700 ft.), CAT IIIb (≤ 150 ft.), or CAT IIIc (0 ft.)	☐	_____
Circling Approach	☐	_____
Windshear Training:	☐	_____
Windshear Training IAW 121.409(d) (121 Turbojets Only)	☐	_____
Generic Unusual Attitudes and Recoveries within the Normal Flight Envelope	☐	_____
Specific Unusual Attitudes Recoveries	☐	_____
Auto-coupled Approach/Auto Go Around	☐	_____
Auto-land / Roll Out Guidance	☐	_____
TCAS/ACAS I / II	☐	_____
WX-Radar	☐	_____
HUD	☐	_____
HGS	☐	_____
EFVS	☐	_____
Future Air Navigation Systems	☐	_____
GPWS / EGPWS	☐	_____
ETOPS Capability	☐	_____
GPS	☐	_____
SMGCS	☐	_____
Helicopter Slope Landings	☐	_____
Helicopter External Load Operations	☐	_____
Helicopter Pinnacle Approach to Landings	☐	_____
Helicopter Night Vision Maneuvers	☐	_____
Helicopter Category A Takeoffs	☐	_____

Attachment 4 to Appendix B to Part 60—
Figure B4G – Sample Statement of Qualification;– List of Qualified Tasks
INFORMATION

CERTIFICATE OF QUALIFICATION
List of Qualified Tasks

Go Fast Airline Training -- Farnsworth Z-100 -- Level D -- FAA ID# 999

The FTD is qualified to perform all of the tasks listed in Appendix 1, Table B1B for its assigned level of qualification *except* for the following listed tasks.

Qualified for all tasks in Table B1B, for which the sponsor has requested qualification, except for the following:	
4.e.	Circling Approach
6. (a)	Emergency Descent (maximum rate)
6. (b)	Inflight Fire and Smoke Removal
6. (c)	Rapid Decompression
6. (d)	Emergency Evacuation

Additional tasks for which this FTD is qualified (i.e., in addition to the list in Table B1B):
NONE

Attachment 4 to Appendix B to Part 60—
Figure B4H – Sample Continuing Qualification Evaluation Requirements Page
INFORMATION

Continuing qualification Evaluation Requirements ***Completed at conclusion of Initial Evaluation***	
Continuing qualification Evaluations to be conducted each _(fill in)__ months Allotting _____ hours of FTD time. Signed: _____ NSPM / Evaluation Team Leader	Continuing qualification evaluations are due as follows: _(month)__ and __(month)_ and __(month)_ (enter or strike out, as appropriate) _____ Date

Revision: Based on (enter reasoning):	
Continuing qualification Evaluations are to be conducted each _(fill in)__ months. Allotting _____ hours. Signed: _____ NSPM / Evaluation Team Leader	Continuing qualification evaluations are due as follows: _(month)__ and __(month)_ and __(month)_ (enter or strike out, as appropriate) _____ Date

Revision: Based on (enter reasoning):	
Continuing qualification Evaluations are to be conducted each _(fill in)__ months. Allotting _____ hours. Signed: _____ NSPM / Evaluation Team Leader	Continuing qualification evaluations are due as follows: _(month)__ and __(month)_ and __(month)_ (enter or strike out, as appropriate) _____ Date

(Repeat as Necessary)

Index of Effective FSTD Directives Filed in this Section			
Number	**Effective Date**	**Date of Notification**	**Details**

Continue as Necessary....

Issued under authority provided by 49 U.S.C. 106(f), 44701(a), 44703, and Pub. L. 111–216, 124 Stat. 2348 (49 U.S.C. 44701 note) in Washington, DC, on June 24, 2014.

John Barbagallo,

Acting Deputy Director, Flight Standards Service.

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