controls and artificial feel systems. Instead of free response measurements, the system would be validated by measurements of control force and rate of movement.
(2) For each axis of pitch, roll, and yaw, the control shall be forced to its maximum extreme position for the following distinct rates. These tests would be conducted at typical taxi, takeoff, cruise, and landing conditions.
(a) Static Test—Slowly move the control such that approximately 100 seconds are required to achieve a full sweep. A full sweep is defined as movement of the controller from neutral to the stop, usually aft or right stop, then through the neutral position to the opposite stop, then to the neutral position.
(b) Slow Dynamic Test—Achieve a full sweep in approximately 10 seconds.
(c) Fast Dynamic Test—Achieve a full sweep in approximately 4 seconds.
(**Note:** Dynamic sweeps may be limited to forces not exceeding 100 lb.)
e. (3) Tolerances.
(1) Static Test—Items **3**.a.(1) (2) and (3) of this attachment.
(2) Dynamic Test—2 lb. or 10 percent on dynamic increment above static test.
f. The NPSM is open to alternative means such as the one described above. Such alternatives, however, would have to be justified and found appropriate to the application. For example, the method described here may not apply to all manufacturers' systems and certainly not to airplanes with reversible control systems. Hence, each case must be considered on its own merit on an ad hoc basis. If the NSPM finds that alternative methods do not result in satisfactory simulator performance, then more conventionally accepted methods must be used.
End Information
6. Ground Effect
Begin Information
a. During landing and takeoff, airplanes operate close to the ground for brief time intervals. The presence of the ground significantly modifies the air flow past the airplane and changes the aerodynamic characteristics. The close proximity of the ground imposes a barrier which inhibits the downward flow normally associated with the production of lift. The downwash is a function of height with the effects usually considered to be negligible above a height of approximately one wingspan. There are three main effects of the reduced downwash:
(1) A reduction in downwash angle at the tail for a conventional configuration.
(2) An increase in both wing and tail lift because of changes in the relationship of lift coefficient to angle of attack (increase in lift curve slope).
(3) A reduction in the induced drag.
b. Relative to out-of-ground effect flight (at a given angle of attack), these effects result in higher lift in ground effect and less power required for level flight. Because of the associated effects on stability, they also cause significant changes in elevator (or stabilizer) angle to trim and stick (column) forces required to maintain a given lift coefficient in level flight near the ground.
c. For a simulator to be used for takeoff and in particularly landing credit, it must faithfully reproduce the aerodynamic changes which occur in ground effect. The parameters chosen for simulator validation must obviously be indicative of these changes. The primary validation parameters for longitudinal characteristics in ground effect are:
(1) Elevator or stabilizer angle to trim.
(2) Power (thrust) required for level flight (PLF).
(3) Angle of attack for a given lift coefficient.
(4) Height/altitude.
(5)Airspeed.
d. The above list of parameters assumes that ground effect data is acquired by tests during ''fly-bys'' at several altitudes in and out of ground effect. These test altitudes would normally, as a minimum, be at 10 percent, 30 percent, and 70 percent of the airplane wingspan and one altitude out of ground effect; *e.g.*, 150 percent of wingspan. Level fly-bys are required for Level D; and, while they are acceptable for all levels, they are not required for Level C and Level B.
e. If, in lieu of the level fly-by method for Levels B and C, other methods such as shallow glidepath approaches to the ground maintaining a chosen parameter constant are proposed, then additional validation parameters are important. For example, if constant attitude shallow approaches are chosen as the test maneuver, pitch attitude, and flight path angle are additional necessary validation parameters. The selection of the test methods and procedures to validate ground effect is at the option of the organization performing the flight tests; however, rationale must be provided to conclude that the tests performed do indeed validate the ground effect model.
f. Tolerances (longitudinal parameters) for validation of ground effect characteristics are:
(1) Elevator or Stabilizer Angle ±1°
(2) Power for Level Flight (PLF)±5%
(3) Angle of Attack ±1°
(4) Altitude/Height ±10% or 5 feet (1.5 m.)
(5) Airspeed ±3 Knots
(6) Pitch Attitude ±1°
g.The lateral-directional characteristics are also altered by ground effect. Because of the above-mentioned changes in lift curve slope, roll damping, as an example, is affected. The change in roll damping will affect other dynamic modes usually evaluated for simulator 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 must be accounted for in the simulator modeling. Several tests such as ''crosswind landing,'' ''one engine inoperative landing,'' and ''engine failure on takeoff'' serve to validate lateral-directional ground effect since portions of them are accomplished while transiting altitudes at which ground effect is an important factor.
End Information
7. Motion Cue Repeatability
Begin Information
a. The motion system characteristics in the Table of Objective Tests address basic system capability, but not pilot cueing capability. Until there is an objective procedure for determination of the motion cues necessary to support pilot tasks and stimulate the pilot response which occurs in an airplane for the same tasks, motion systems will continue to be ''tuned'' subjectively. Having tuned a motion system, however, it is important to involve a test to ensure that the system continues to perform as originally qualified. Any motion performance change from the initially qualified baseline can be measured objectively.
b. An objective assessment of motion performance change is accomplished at lease annually using the following testing procedure:
(1) The current performance of the motion system is assessed by comparison with the initial recorded test data.
(2) The parameters to be recorded are the outputs of the motion drive algorithms and the jack position transducers.
(3) The test input signals are inserted at an appropriate point prior to the integrations in the equations of motion (see figure 3 of this attachment).
(4) The characteristics of the test signal (see figure 4) are adjusted to ensure that the motion is exercised through approximately 2/3 of the maximum displacement capability in each axis. The time segment T_0–T_1, must be of sufficient duration to ensure steady initial conditions.
End Information

Ttachment 2 to Appendix A To Part 60 – Figure 2
CRITICAL-DAMPED STEP RESPONSE

Figure 2. --- "0.1 of Ad" should be at 90% Ad, i.e. in line with T(p0) marking.

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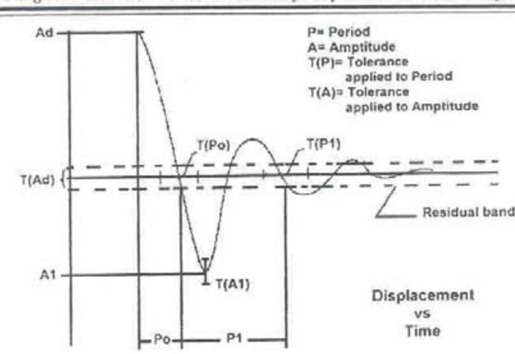
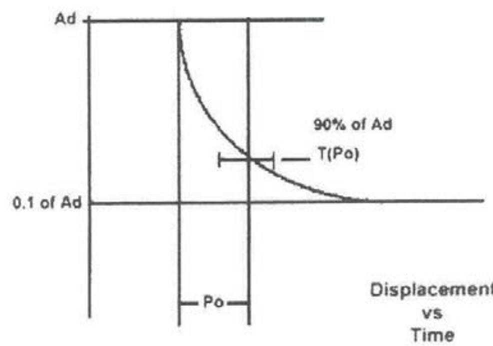


ATTACHMENT 2 TO APPENDIX A TO PART 60—

FIGURE 1. UNDER-DAMPED STEP RESPONSE



ATTACHMENT 2 TO APPENDIX A TO PART 60—

FIGURE 2. CRITICALLY-DAMPED STEP RESPONSE

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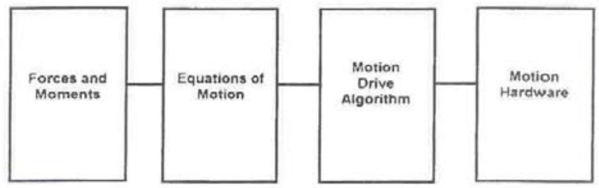
ATTACHMENT 2 TO APPENDIX A TO PART 60—

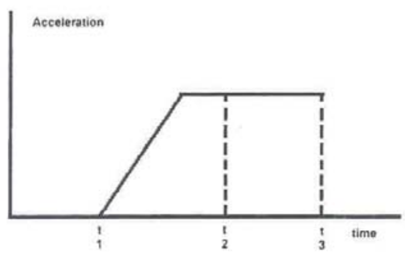
FIGURE 3. ACCELERATION TEST SIGNALS



Note to Figure 3: If the simulator weight changes for any reason (*i.e.*, visual change, or structural change), then the motion system baseline performance repeatability tests must be rerun and the new results used for future comparison.

ATTACHMENT 2 TO APPENDIX A TO PART 60—

FIGURE 4, ACCELERATION TEST SIGNAL



BILLING CODE 4910–13–C

Note to Figure 4: If the simulator weight changes for any reason (*i.e.*, visual change, or structural change), then the motion system baseline performance repeatability tests must be rerun and the new results used for future comparison.

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

---

Begin Information

a. In recent years, considerable progress has been made by highly experienced aircraft and simulator manufacturers in improvement of aerodynamic modeling techniques. In conjunction with increased accessibility to very high powered computer technology, these techniques have become quite sophisticated. Additionally, those who have demonstrated success in combining these modeling techniques with minimal flight testing have incorporated the use of highly mature flight controls models and have had extensive experience in comparing the output of their effort with actual flight test data—and they have been able to do so on an iterative basis over a period of years.

b. It has become standard practice for experienced simulator manufacturers to use such techniques as a means of establishing data bases for new simulator 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 A and Level B simulators.

c. In reviewing this history, the NSPM has concluded that, with proper care, those who are experienced in the development of aerodynamic models for simulator 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 A or Level B simulators, does not compromise the quality of that simulation.

d. The information in the table that follows (Table of Alternative Data Sources,

Note to Figure 4: If the simulator weight changes for any reason (*i.e.*, visual change, or structural change), then the motion system baseline performance repeatability tests must be rerun and the new results used for future comparison.

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c. In reviewing this history, the NSPM has concluded that, with proper care, those who are experienced in the development of aerodynamic models for simulator 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 A or Level B simulators, does not compromise the quality of that simulation.

d. The information in the table that follows (Table of Alternative Data Sources, Procedures, and Information) is presented to describe an acceptable alternative to data sources for simulator modeling and validation and as an acceptable alternative to the procedures and instrumentation found in the traditionally accepted flight test methods used to gather such modeling and validation data.

(1) Alternative data sources which 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 the following Table 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 simulator aerodynamic program modeling.

(1) While the 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. 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 ‘‘flyby’’ trim data will be the acceptable norm for normal and cross-control input landing objective data for these applications.)

(2) 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, will be used. Such a model does not require control surface position measurements in the flight test objective data in these limited applications.

(3) The authorized uses of Level A and Level B simulators (as listed in the appropriate Commercial, Instrument, or Airline Transport Pilot and/or Type Rating Practical Test Standards) for ‘‘initial,’’ ‘‘transition,’’ or ‘‘upgrade’’ training, still requires additional flight training and/or flight testing/checking in the airplane or in a Level C or Level D simulator.

f. The sponsor is urged to contact the NSPM for clarification of any issue regarding airplanes with reversible control systems. This table is not applicable to Computer Controlled Aircraft flight simulators.

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 A or Level B flight simulators.

End Information

Procedures, and Information) is presented to describe an acceptable alternative to data sources for simulator modeling and validation and as an acceptable alternative to the procedures and instrumentation found in the traditionally accepted flight test methods used to gather such modeling and validation data.

(1) Alternative data sources which 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.

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(3) The authorized uses of Level A and Level B simulators (as listed in the appropriate Commercial, Instrument, or Airline Transport Pilot and/or Type Rating Practical Test Standards) for "initial," "transition," or "upgrade" training, still requires additional flight training and/or flight testing/checking in the airplane or in a Level C or Level D simulator.

f. The sponsor is urged to contact the NSPM for clarification of any issue regarding airplanes with reversible control systems. This table is not applicable to Computer Controlled Aircraft flight simulators.

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 A or Level B flight simulators.

End Information

TABLE OF ALTERNATIVE DATA SOURCES, PROCEDURES, AND INSTRUMENTATION INFORMATION

Table of objective test—test reference number and title	Sim level A	Sim level B	Aternative data sources, procedures, and instrumentation	Notes and reminders
2.a.(1) Performance. Taxi. Minimum Radius turn.	X	X	TIR, AFM, or Design data may be used.	
2.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.
2.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.	
2.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: the calibrated airplane instruments and the force/position measurements of cockpit controls.	Rapid throttle reductions at speeds near V_{mcg} may be used while recording appropriate parameters. The nose wheel must be free to caster, or equivalently freed of sideforce generation.
2.b.(4) Performance. Takeoff. Normal Takeoff.	X	X	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 cockpit controls. AOA can be calculated from pitch attitude and flight path.	
2.b.(5) Performance. Takeoff. Critical Engine Failure during Takeoff.	X	X	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 cockpit controls.	Record airplane dynamic response to engine failure and control inputs required to correct flight path.

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TABLE OF ALTERNATIVE DATA SOURCES, PROCEDURES, AND INSTRUMENTATION INFORMATION—Continued

Table of objective test—test reference number and title	Sim level		Alternative data sources, procedures, and instrumentation	Notes and reminders
	A	B		
2.b.(6) Performance. Takeoff. Crosswind Takeoff.	X	X	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 cockpit controls.	The "1:7 law" to 100 feet (30 meters) is an acceptable wind profile.
2.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.	
2.c.(1) Performance. Climb. Normal Climb.	X	X	Data may be acquired with a synchronized video of: calibrated airplane instruments and engine power throughout the climb range.	
2.c.(2) Performance. Climb. One engine Inoperative Second Segment Climb.	X	X	Data may be acquired with a synchronized video of: calibrated airplane instruments and engine power throughout the climb range.	
2.c.(4) Performance. Climb. One Engine Inoperative Approach Climb (if Approved AFM requires specific performance in icing conditions).	X	X	Data may be acquired with a synchronized video of: calibrated airplane instruments and engine power throughout the climb range.	
2.e.(1) Performance. Ground. Deceleration Time and Distance, using manual application of wheel brakes and no reverse thrust.	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.	
2.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 the pertinent parameters of engine power.	
2.f.(1) Performance. Engines. Acceleration.	X	X	Data may be acquired with a synchronized video recording of: engine instruments and throttle position.	
2.f.(2) Performance. Engines. Deceleration.	X	X	Data may be acquired with a synchronized video recording of: engine instruments and throttle position.	
3.a.(1) Handling Qualities. Static Control Checks. Column 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 with winds less than 5 kts. Force data may be acquired by using a hand held force gauge at the same column position data points.	

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TABLE OF ALTERNATIVE DATA SOURCES, PROCEDURES, AND INSTRUMENTATION INFORMATION—Continued

Table of objective test—test reference number and title	Sim level A	Sim level B	Alternative data sources, procedures, and instrumentation	Notes and reminders
3.a.(2) Handling Qualities. Static Control Checks. Wheel 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 with winds less than 5 kts. Force data may be acquired by using a hand held force gauge at the same wheel position data points.	
3.a.(3) Handling Qualities. Static Control Checks. Rudder Pedal 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 rudder pedal positions (encompassing significant rudder pedal position data points), acceptable to the NSPM, using a control surface protractor on the ground with winds less than 5 kts. Force data may be acquired by using a hand held force gauge at the same rudder pedal position data points.	
3.a.(4) Handling Qualities. Static Control Checks. Nosewheel Steering Force & 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.	
3.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 nose wheel position.	
3.a.(6) Handling Qualities. Static Control Checks. Pitch Trim Calibration (Indicator vs. Computed) and Rate.	X	X	Data may be acquired through calculations.	
3.a.(7) Handling Qualities. Static Control Checks. Alignment of Power Lever Angle vs Selected Engine Parameter (e.g., EPR, N_1, Torque, etc.).	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.	
3.a.(8) Handling Qualities. Static Control Checks. Brake Pedal Position vs. Force and Brake System Pressure.	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.	
3.c.(1) Handling Qualities. Longitudinal. Power Change Dynamics.	X	X	Data may be acquired by using an inertial measurement system and a synchronized video of: the calibrated airplane instruments and throttle position.	
3.c.(2) Handling Qualities. Longitudinal. 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.	

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TABLE OF ALTERNATIVE DATA SOURCES, PROCEDURES, AND INSTRUMENTATION INFORMATION—Continued

Table of objective test—test reference number and title	Sim level		Alternative data sources, procedures, and instrumentation	Notes and reminders
	A	B		
3.c.(3) Handling Qualities. Longitudinal. Spoiler/Speedbrake Change.	X	X	Data may be acquired by using an inertial measurement system and a synchronized video of: the calibrated airplane instruments and spoiler/speedbrake position.	
3.c.(4) Handling Qualities. Longitudinal. Gear Change Dynamics.	X	X	Data may be acquired by using an inertial measurement system and a synchronized video of: the calibrated airplane instruments and gear position.	
3.c.(5) Handling Qualities. Longitudinal. Alternate Landing Gear and Alternate Flap/Slat Operating Times.	X	X	May use design data, production flight test schedule, or maintenance specification, together with an SOC.	
3.c.(6) Handling Qualities. Longitudinal. Longitudinal Trim.	X	X	Data may be acquired through use of an inertial measurement system and a synchronized video of: the cockpit controls position (previously calibrated to show related surface position) and the engine instrument readings.	
3.c.(7) Handling Qualities. Longitudinal. 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: the calibrated airplane instruments; a temporary, high resolution bank angle scale affixed to the attitude indicator; and column force measurement indication.	
3.c.(8) Handling Qualities. Longitudinal. Longitudinal Static Stability.	X	X	Data may be acquired through the use of a synchronized video of: the airplane flight instruments and a hand held force gauge.	
3.c.(9) Handling Qualities. Longitudinal. Stick Shaker, Airframe Buffet, Stall Speeds.	X	X	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.	
3.c.(10) Handling Qualities. Longitudinal. Phugoid Dynamics.	X	X	Data may be acquired by using an inertial measurement system and a synchronized video of: the calibrated airplaine instruments and the force/position measurements of cockpit controls.	
3.c.(11) Handling Qualities. Longitudinal. Short Period Dynamics.	X	X	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 cockpit controls.	
3.d.(1) Handling Qualities. Lateral Directional. Minimum Control Speed, Air (V_{mca}), per Applicable Airworthiness Standard or Low Speed Engine. Inoperative Handling Characteristics in Air.	X	X	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 cockpit controls.	
3.d.(3) Handling Qualities. Lateral Directional. Roll Response to Cockpit Roll Controller Step Input.	X	X	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 cockpit controls.	

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TABLE OF ALTERNATIVE DATA SOURCES, PROCEDURES, AND INSTRUMENTATION INFORMATION—Continued

Table of objective test—test reference number and title	Sim level		Aternative data sources, procedures, and instrumentation	Notes and reminders
	A	B		
3.d.(4) Handling Qualities. Lateral Directional. Spiral Stability.	X	X	Data may be acquired by using an inertial measurement system and a synchronized video of: the calibrated airplane instruments; the force/position measurements of cockpit controls; and a stop watch.	
3.d.(5) Handling Qualities. Lateral Directional. 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: the calibrated airplane instruments; and the fore/position measurements of cockpit controls.	Trimming during second segment climb is not a certification task and should not be conducted until a safe altitude is reached.
3.d.(6) Handling Qualities. Lateral Directional. Rudder Response.	X	X	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.	
3.d.(7) Handing Qualities. Lateral Directional. Dutch Roll, (Yaw Damper OFF).	X	X	Data may be acquired by using an inertial measurement system and a synchronized video of: a calibrated airplane instruments; the force/position measurements of cockpit controls.	
3.d.(8) Handling Qualities. Laterial Directional. Steady State Sideslip.	X	X	Data may be acquired by using an inertial measurement system and a synchronized video of: the calibrated airplane instruments; the force/position measurements of cockpit controls. Ground track and wind corrected heading may be used for sideslip angle.	
3.e.(1) Handling Qualities. Landings Normal Landing.		X	Data may be acquired by using an inertial measurement system and a synchronized video of: the calibrated airplane instruments; the force/position measurements of cockpit controls.	
3.e.(3) Handling Qualities. Landings. Crosswind Landing.		X	Data may be acquired by using an inertial measurement system and a synchronized video of: the calibrated airplane instruments; the force/position measurements of cockpit controls.	
3.e.(4) Handling Qualities. Landings. One Engine Inoperative Landing (Not required for Single-engine airplanes.).		X	Data may be acquired by using an inertial measurement system and a synchronized video of: the calibrated airplane instruments; the force/position measurements of cockpit controls. Normal and laterial acceleration may be recorded in lieu of AOA and sideslip.	
3.f. Handling Qualities. Ground Effect. Demonstrate Longitudinal Ground Effect.		X	Data may be acquired by using an calibrated airplane instruments, an inertial measurement system, and a synchronized video of: the calibrated airplane instruments; the force/position measurements of cockpit controls.	

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

1. Discussion

Begin Information

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 satisfactorily meets the appropriate training/testing/checking objectives and competently simulates each required maneuver, procedure, or task; and verifying correct operation of the simulator controls, instruments, and systems. The items in the list of operations tasks are for simulator evaluation purposes only. They must not be used to limit or exceed the authorizations for use of a given level of simulator as found in the Pilot Qualification Performance Standards or as may be approved by the TPAA. All items in the following paragraphs are subject to an examination of function.

b. The List of Operations Tasks in paragraph 2 of this attachment addresses pilot functions, including maneuvers and procedures (called flight tasks), and is 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 List of Simulator Systems in paragraph 3 of this attachment addresses the overall function and control of the simulator including the various simulated environmental conditions; simulated airplane system operation (normal, abnormal, and emergency); visual system displays; and special effects necessary to meet flightcrew 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 recommended for approval for the circling approach maneuver as determined by the TPAA in the sponsor’s FAA-approved flight training program. To be considered satisfactory here, the circling approach will be flown at maximum gross weight for landing, with minimum visibility, 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—14CFR, § 91.175(e)).

f. At the request of the TPAA, the NSP Pilot may assess the simulator 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 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 simulator.

End Information

2. List of Operations Tasks

Begin QPS Requirements

The NSPM will evaluate the simulator in the following Operations Tasks, as applicable to the airplane and simulator level, using the sponsor’s approved manuals and checklists.

a. Preparation for Flight

Preflight. Accomplish a functions check of all installed switches, indicators, systems, and equipment at all crewmembers’ and instructors’ stations, and determine that the cockpit design and functions replicate the appropriate airplane.

b. Surface Operations (Pre-Takeoff)

(1) Engine start.
(a) Normal start.
(b) Alternate start operations.
(c) Abnormal starts and shutdowns (hot start, hung start, *etc.*).
(2) Pushback / Powerback.
(3) Taxi
(a) Thrust response.
(b) Power lever friction.
(c) Ground handling.
(d) Nosewheel scuffing.
(e) Brake operation (normal and alternate/emergency).
(f) Ground hazard.
(g) Surface Movement and Guidance System (SMGS).
(h) Other.

c. Takeoff

(1) Normal. (Day, Night, Dusk (or Twilight))
(a) Propulsion system checks (*e.g.*, engine parameter relationships; propeller and mixture controls).
(b) Airplane acceleration characteristics.
(c) Nosewheel and rudder steering.
(d) Crosswind (maximum demonstrated).
(e) Special performance.
(f) Lowest visibility takeoff.
(g) Landing gear, wing flap, leading edge device operation.
(h) Other.
(2) Abnormal/Emergency.
(a) Rejected, with brake fade (if applicable) due to rising brake temperature.
(b) Rejected, special performance.
(c) With propulsion system malfunction:
(i) Prior to V_1 (decision) speed.
(ii) Between V_1 and V_r (rotation speed).
(iii) Between V_r and 500 feet above ground level.
(d) Flight control system failure modes.
(e) Other.

d. Inflight Operation

(1) Climb.
(a) Normal.
(b) One engine inoperative operations.
(c) Other.
(2) Cruise.
(a) Performance characteristics (speed vs. power).
(b) Normal turns and turns with/without spoilers (speed brake) deployed.
(c) High altitude handling.
(d) High indicated airspeed handling, overspeed warning.
(e) Mach effects on control and trim.
(f) Normal and steep turns.
(g) Performance turns.
(h) Approach to stalls in the following configurations:
(i) Cruise;
(ii) Takeoff or approach; and
(iii) Landing.
(a) High angle of attack maneuvers in the following configurations:
(i) Cruise;
(ii) Takeoff or approach; and
(iii) Landing.
(j) Inflight engine shutdown.
(k) Inflight engine restart.
(l) Maneuvering with one or more engines inoperative, as applicable.
(m) Slow flight.
(n) Specific flight characteristics.
(o) Manual flight control reversion (*i.e.*, loss of all flight control power).
(p) Other flight control system failure modes.
(q) Holding.
(r) Airborne hazard.
(s) Operations during icing conditions.
(t) Upset / disturbance recovery.
(u) Unusual attitude recovery.
(v) Traffic alert and collision avoidance.
(w) Effects of airframe icing.
(x) Other.
(3) Descent.
(a) Normal.
(b) Maximum rate (clean, with speedbrake extended, etc.) and recovery.
(c) Flight Control System Failure Modes (*e.g.*, manual flight control reversion; split controls, *etc.*).
(d) High rate of sink and recovery.
(a) Other.

e. Approaches

(1) Instrument Approach Maneuvers.
(a) Non-precision:
(i) Non-Directional Beacon (NDB).
(ii) VHF Omni-Range (VOR), Area Navigation (RNAV), Tactical Air Navigation (TACAN).
(iii) Distance Measuring Equipment, Arc (DME ARC).
(iv) ILS Localizer Back Course (LOC/BC).
(v) Localizer Directional Aid (LDA), ILS Front Course Localizer (LOC), Simplified Direction Facility (SDF).
(vi) Airport Surveillance Radar (ASR).
(vii) Global Positioning System (GPS).
(viii) With one engine inoperative.

(ix) Missed approach.
(b) Precision:
(i) Instrument Landing System (ILS)
A. Category I published:
1. Manually controlled with and without flight director to 100 feet below published decision height.
2. With maximum demonstrated crosswind.
3. With windshear.
4. One engine inoperative.
B. Category II published:
1. With and without use of autopilot, autothrottle, and autoland, as applicable.
2. One engine inoperative.
C. Category III published:
1. With minimum/standby electrical power.
2. With generator/alternator failure (transient).
3. With 10 knot tail wind.
4. With 10 knot crosswind.
5. Rollout.
6. One engine inoperative.
D. Missed approach.
1. All engines operating.
2. One engine inoperative.
(ii) Precision Approach Radar (PAR)
A. Normal.
B. With crosswind.
C. With one engine inoperative.
D. Missed approach.
(iii) Digital Global Positioning System (DGPS)
A. Normal.
B. With crosswind.
C. With one engine inoperative.
D. Missed approach.
(iv) Microwave landing system (MLS).
A. Normal.
B. With crosswind.
C. With one engine inoperative.
D. Missed approach.
(v) Steep Glide Path.
A. Normal.
B. With crosswind.
C. With one engine inoperative.
D. Missed approach.
(2) Visual Approach Maneuvers.
(a) Abnormal wing flaps/slats.
(b) Without glide slope guidance or visual vertical flightpath aid.
(3) Abnormal/emergency.
(a) With one engine inoperative.
(b) With standby (or minimum) electric/hydraulic power.
(c) With longitudinal trim malfunction.
(d) With jammed or mis-trimmed horizontal stabilizer.
(e) With lateral-directional trim malfunction.
(f) With worst case failure of flight control system (most significant degradation of the computer controlled airplane which is not extremely improbable).
(g) Other flight control system failure modes as dictated by training program.
(h) Land and hold short operations.
(i) Other.
f. Missed Approach
(1) Manual.
(2) Automatic (if applicable).
g. Visual Segment and Landing
(1) Normal (Night visual scene for Level A and Level B simulators; Night and Dusk (or Twilight) visual scenes for Level C simulators; and Night, Dusk (or Twilight), and Daylight visual scenes for Level D simulators.)
(a) From visual traffic pattern.
(b) From non-precision approach.
(c) From precision approach.
(d) With maximum demonstrated crosswind.
(e) From circling approach.
(2) Abnormal/emergency.
(a) With engine(s) inoperative—
(i) For 2-engine airplanes, one engine inoperative.
(ii) For 3-engine airplanes, one wingmounted and the center engine inoperative.
(iii) For other multi-engine airplanes, a 50% power loss on one side of the airplane.
(b) Rejected landing.
(c) With standby (or minimum) electric/hydraulic power.
(d) With longitudinal trim malfunction
(e) With jammed or mis-trimmed horizontal stabilizer.
(f) With lateral-directional trim malfunction.
(g) With worst case failure of flight control system (most significant degradation of the computer controlled airplane which is not extremely improbable).
(h) Other flight control system failure modes as dictated by training program.
(i) Land and hold short operations.
(j) Other.
h. Windshear
(1) Takeoff.
(2) Climb.
(3) Approach.
i. Surface Operations (Post Landing)
(1) Landing roll.
(2) Spoiler operation.
(3) Reverse thrust operation.
(4) Wheel brake operation.
(5) Ground hazard.
(6) Surface Movement and Guidance System (SMGS).
(7) Other.
J. Any Flight Phase
(1) Air conditioning.
(2) Anti-icing/deicing.
(3) Auxiliary powerplant.
(4) Communications.
(5) Electrical.
(6) Fire detection and suppression.
(7) Flaps/Slats.
(8) Flight controls (including spoiler/speedbrake).
(9) Fuel and oil.
(10) Hydraulic.
(11) Landing gear.
(12) Oxygen.
(13) Pneumatic.
(14) Propulsion System.
(15) Pressurization.
(16) Flight management and guidance systems.
(17) Automatic landing aids.
(18) Automatic pilot.
(19) Thrust management/auto-throttle.
(20) Flight data displays.
(21) Flight management computers.
(22) Flight director/system displays.
(23) Flight Instruments.
(24) Heads-up flight guidance system.
(25) Navigation systems.
(26) Weather radar system.
(27) Stall warning/avoidance.
(28) Stability and control augmentation.
(29) ACARS.
(30) Other
k. Engine Shutdown and Parking
(1) Systems operation.
(2) Parking brake operation.

3. List of Simulator Systems

a. Instructor Operating Station (IOS)
(1) Power switch(es).
(2) Airplane conditions.
(a) Gross weight, center of gravity, fuel loading and allocation, *etc.*
(b) Airplane systems status.
(c) Ground crew functions (*e.g.*, external power connections, push back, *etc.*)
(d) Other.
(3) Airports.
(a) Number and selection.
(b) Runway selection.
(c) Runway surface condition (*e.g.*, rough, smooth, icy, wet, dry, *etc.*)
(d) Preset positions (*e.g.* ramp, gate, #1 for takeoff, takeoff position, over FAF, *etc.*)
(e) Lighting controls.
(f) Other.
(4) Environmental controls.
(a) Clouds (base and tops).
(b) Visibility (statute miles (kilometers)).
(c) Runway visual range (in feet (meters)).
(d) Temperature.
(e) Climate conditions (*e.g.*, ice, snow, rain, *etc.*).
(f) Wind speed and direction.
(g) Windshear.
(h) Other.
(5) Airplane system malfunctions.
(a) Insertion/deletion.
(b) Problem clear.
(c) Other
(6) Locks, Freezes, and repositioning.
(a) Problem (all) freeze/release.
(b) Position (geographic) freeze/release.
(c) Repositioning (locations, freezes, and releases).
(d) Two times or one-half ground speed control.
(e) Other
(7) Remote IOS.
(8) Other.
b. Sound Controls—On/Off/Rheostat
c. Motion/Control Loading System
(1) On/off/emergency stop.
(2) Crosstalk (motion response in a given degree of freedom not perceptible in other degrees of freedom).
(3) Smoothness (no perceptible ''turn-around bump'' as the direction of motion reverses with the simulator being ''flown'' normally).
d. Observer Stations
(1) Position.
(2) Adjustments.
(3) Positive seat restraint system.

End QPS Requirements

Attachment 4 to Appendix A to Part 60—Definitions and Abbreviations

1. Definitions

Begin Regulatory Language (14 CFR Part 1 and § 60.3)

(From Part 1—Definitions)

Flight simulation device (FSD) means a flight simulator or a flight training device.

Flight simulator means a full size replica of a specific type or make, model, and series aircraft cockpit. It includes the assemblage of equipment and computer programs necessary to represent the aircraft in ground and flight operations, a visual system providing an outof-the-cockpit view, a system that provides cues at least equivalent to those of a threedegree-of-freedom motion system, and having the full range of capabilities of the systems installed in the device as described in part 60 of this chapter and the qualification performance standards (QPS) for a specific qualification level.

Flight training device (FTD) means a full size replica of aircraft instruments, equipment, panels, and controls in an open flight deck area or an enclosed aircraft cockpit replica. It includes the equipment and computer programs necessary to represent the aircraft or set of aircraft in ground and flight conditions having the full range of capabilities of the systems installed in the device as described in part 60 of this part and the qualification performance standard (QPS) for a specific qualification level.

(From Part 60—Definitions)

Certificate holder. A person issued a certificate under parts 119, 141, or 142 of this chapter or a person holding an approved course of training for flight engineers in accordance with part 63 of this chapter.

Flight test data. Actual aircraft performance data obtained by the aircraft manufacturer (or other supplier of data acceptable to the NSPM) during an aircraft flight test program.

FSD Directive. A document issued by the FAA to an FSD sponsor, requiring a modification to the FSD due to a recognized safety-of-flight issue and amending the qualification basis for the FSD.

Master Qualification Test Guide (MQTG). The FAA-approved Qualification Test Guide with the addition of the FAA-witnessed test, performance, or demonstration results, applicable to each individual FSD.

National Simulator Program Manager (NSPM). The FAA manager responsible for the overall administration and direction of the National Simulator Program (NSP), or a person approved by the NSPM .

Objective test. A quantitative comparison of simulator performance data to actual or predicted aircraft performance data to ensure FSD performance is within the tolerances prescribed in the QPS.

Predicted data. Aircraft performance data derived from sources other than direct physical measurement of, or flight tests on, the subject aircraft. Predicted data may include engineering analysis and simulation, design data, wind tunnel data, estimations or extrapolations based on existing flight test data, or data from other models.

Qualification level. The categorization of the FSD, based on its demonstrated technical and operational capability as set out in the QPS.

Qualification Performance Standard (QPS). The collection of procedures and criteria published by the FAA to be used when conducting objective tests and subjective tests, including general FSD requirements, for establishing FSD qualification levels.

Qualification Test Guide (QTG). The primary reference document used for evaluating an aircraft FSD. It contains test results, performance or demonstration results, statements of compliance and capability, the configuration of the aircraft simulated, and other information for the evaluator to assess the FSD against the applicable regulatory criteria.

Set of aircraft. Aircraft that share similar handling and operating characteristics and similar operating envelopes and have the same number and type of engines or power plants.

Sponsor. A certificate holder who seeks or maintains FSD qualification and is responsible for the prescribed actions as set out in this part and the QPS for the appropriate FSD and qualification level.

Subjective test. A qualitative comparison to determine the extent to which the FSD performs and handles like the aircraft being simulated.

Training Program Approval Authority (TPAA). A person authorized by the Administrator to approve the aircraft flight training program in which the FSD will be used.

Upgrade. The improvement or enhancement of an FSD for the purpose of achieving a higher qualification level.

End Regulatory Language (14 CFR Part 1 and § 60.3)

Begin QPS Requirements

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

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

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

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

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

Automatic Testing—is simulator testing wherein all stimuli are under computer control.

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

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

Closed Loop Testing—is a test method for which the input stimuli are generated by controllers which drive the simulator to follow a pre-defined target response.

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

Computer Controlled Airplane—is an airplane where all pilot inputs to the control surfaces are transferred and augmented by computers.

Convertible Flight Simulator—is a simulator in which hardware and software can be changed so that the simulator becomes a replica of a different model, usually of the same type airplane. The same simulator platform, cockpit shell, motion system, visual system, computers, and necessary peripheral equipment can thus be used in more than one simulation.

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

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

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

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

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

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

Fuel used—is the amount or mass of fuel used (kilograms or pounds).

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

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

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

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

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

Integrated Testing—is testing of the simulator such that all airplane system models are active and contribute appropriately to the results where none of the models used are substituted with models or other algorithms intended for testing only.

Irreversible Control System—is a control system in which movement of the control surface will not backdrive the pilot's control in the cockpit.

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

Manual Testing—is simulator testing wherein the pilot conducts the test without computer inputs except for initial setup and all modules of the simulation are active.

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

Nominal—is the normal operational weight, configuration, speed, etc., for the flight segment specified. *Non-Normal Control*—is a term used in reference to Computer Controlled Airplanes

and is the state where one or more of the intended control, augmentation, or protection functions are not fully working. **Note:** Specific terms such as ALTERNATE, DIRECT, SECONDARY, BACKUP, etc., may be used to define an actual level of degradation.
Normal Control—is a term used in reference to Computer Controlled Airplanes and is the state where the intended control, augmentation, and protection functions are fully working.
Pitch—is the airplane attitude with respect to or around the lateral axis expressed in degrees.
Power Lever Angle—is the angle of the pilot's primary engine control lever(s) in the cockpit. This may also be referred to as PLA, THROTTLE, or POWER LEVER.
Protection Functions—are systems functions designed to protect an airplane from exceeding its flight maneuver limitations.
Pulse Input—is a step input to a control followed by an immediate return to the initial position.
Reversible Control System—is a control system in which movement of the control surface will backdrive the pilot's control in the cockpit.
Roll—is the airplane attitude with respect to or around the longitudinal axis expressed in degrees.
Sideslip—is the angular difference between the airplane heading and the direction of movement in the horizontal plane.
Simulation Data—are the various types of data used by the simulator manufacturer and the applicant to design, manufacture, and test the simulator.
Simulator Approval—is the extent to which a simulator may be used by a certificate holder as authorized by the FAA. It takes account of airplane to simulator differences and the training ability of the organization.
Simulator Latency—is the additional time beyond that of the response time of the airplane due to the response of the simulator.
Snapshot—is a presentation of one or more variables at a given instant of time.
Source Data—are, for the purpose of this document, performance, stability and control, and other necessary test parameters electrically or electronically recorded in an airplane using a calibrated data acquisition system of sufficient resolution and verified as accurate by the company performing the test to establish a reference set of relevant parameters to which like simulator parameters can be compared.
Statement of Compliance and Capability (SOC)—is a declaration that specific requirements have been met. It must declare that compliance with the requirement is achieved and explain how the requirement is met (*e.g.*, gear modeling approach, coefficient of friction sources, *etc.*). It must also describe the capability of the simulator to meet the requirement (*e.g.*, computer speed, visual system refresh rate, *etc.*). In doing this, the statement must provide references to needed sources of information for showing compliance, rationale to explain how the referenced material is used, mathematical equations and parameter values used, and conclusions reached.
Step Input—is an abrupt control input held at a constant value.
Surge—is simulator movement with respect to or along the longitudinal axis.
Sway—is simulator movement with respect to or along the lateral axis.
Time History—is a presentation of the change of a variable with respect to time.
Training Program Approval Authority (TPAA)—is the person who exercises authority on behalf of the Administrator in approving the aircraft flight training program for the appropriate airplane in which the simulator will be used. This person is the principal operations inspector (POI) for programs approved under 14 CFR parts 63, 121, 125, or 135; or the training center program manager (TCPM) for programs approved under 14 CFR part 141 or 142.
Transport Delay or ''Throughput''—is the total simulator system processing time required for an input signal from a pilot primary flight control until motion system, visual system, or instrument response. It is the overall time delay incurred from signal input until output response. It does not include the characteristic delay of the airplane simulated.
Validation Data—are data used to determine if the simulator performance corresponds to that of the airplane.
Validation Test—is a test by which simulator parameters are compared to the relevant validation data.
Visual System Response Time—is the interval from a control input to the completion of the visual display scan of the first video field containing the resulting different information.
Yaw—is airplane attitude with respect to or around the vertical axis expressed in degrees.
End QPS Requirements

2. Abbreviations

Begin QPS Requirements

AFM—Approved Flight Manual.
AGL—Above Ground Level (meters or feet).
AOA—Angle of Attack (degrees).
APD—Aircrew Program Designee.
CCA—Computer Controlled Airplane.
cd/m_2 candela/meter$_2$, 3.4263 candela/m_2 = 1 ft-Lambert.
CFR—Code of Federal Regulations.
cm(s)—centimeter, centimeters.
daN—decaNewtons, one (1) decaNewton = 2.27 pounds.
deg(s) degree, degrees.
DOF—Degrees-of-freedom
EPR—Engine Pressure Ratio.
FAA—Federal Aviation Administration (U.S.).
fpm—feet per minute.
ft—foot/feet, 1 foot = 0.304801 meters.\
ft-Lambert—foot-Lambert, 1 ft-Lambert = 3.4263 candela/m_2.
g—Acceleration due to Gravity (meters or feet/sec$_2$); 1g = 9.81 m/sec$_2$ or 32.2 feet/ sec$_2$.
G/S—Glideslope.
IATA—International Airline Transport Association.
ICAO—International Civil Aviation Organization.
ILS—Instrument Landing System.
IQTG—International Qualification Test Guide.
km—Kilometers 1 km = 0.62137 Statute Miles.
kPa—KiloPascal (Kilo Newton/Meters2). 1 psi = 6.89476 kPa.
Kts—Knots calibrated airspeed unless otherwise specified, 1 knot = 0.5148 m/sec or—1.689 ft/sec.
lb(s)—pound(s), one (1) pound = 0.44 decaNewton.
M,m—Meters, 1 Meter = 3.28083 feet.
Min(s)—Minute, minutes.
MLG—h;Main Landing Gear.
Mpa—MegaPascals (1 psi = 6894.76 pascals).
ms—millisecond(s).
N—NORMAL CONTROL Used in reference to Computer Controlled Airplanes.
N1—Low Pressure Rotor revolutions per minute, expressed in percent of maximum.
N2—High Pressure Rotor revolutions per minute, expressed in percent of maximum.
N3—High Pressure Rotor revolutions per minute, expressed in percent of maximum.
nm—Nautical Mile(s) 1 Nautical Mile = 6,080 feet.
NN—NON-NORMAL CONTROL Used in reference to Computer Controlled Airplanes.
NWA—Nosewheel Angle (degrees).
PAPI—Precision Approach Path Indicator System.
PLA—Power Lever Angle.
Pf—Impact or Feel Pressure, often expressed as ''q.''.
PLF—Power for Level Flight.
psi—pounds per square inch.
QPS—Qualification Performance Standard.
RAE—Royal Aerospace Establishment.
R/C—Rate of Climb (meters/sec or feet/min).
R/D—Rate of Descent (meters/sec or feet/ min).
REIL—Runway End Identifier Lights.
RVR—Runway Visual Range (meters or feet).
s—second(s).
sec(s)—second, seconds.
sm—Statute Mile(s) 1 Statute Mile = 5,280 feet.
SOC—Statement of Compliance and Capability.
Tf—Total time of the flare maneuver duration.
Ti—Total time from initial throttle movement until a 10% response of a critical engine parameter.
TIR—Type Inspection Report.
T/O—Takeoff.
Tt—Total time from Ti to a 90% increase or decrease in the power level specified.
VASI—Visual Approach Slope Indicator System.
VGS—Visual Ground Segment.
Vmc—Minimum Control Speed.
Vmca—Minimum Control Speed in the air.
Vmcg—Minimum Control Speed on the

ground.
Vmcl—Minimum Control Speed—Landing.
Vmu—The speed at which the last main landing gear leaves the ground.
Vr—Rotate Speed.

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Vs—Stall Speed or minimum speed in the stall.

WAT—Weight, Altitude, Temperature.

End QPS Requirements

Attachment 5 to Appendix A to Part 60—Sample Documents

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