TABLE OF MINIMUM FLIGHT TRAINING DEVICE REQUIREMENTS INFORMATION

QPS Requirement	FTD level						Additional details	Notes
General FTD Standards	1	2	3	4	5	6		
2. General Cockpit Configuration:								
a. The FTD must have a cockpit that is a full-scale replica of the airplane, or set of airplanes, simulated with controls, equipment, observable cockpit indicators, circuit breakers, and bulkheads properly located, functionally accurate and replicating the airplane or set of airplanes. The direction of movement of controls and switches must be identical to that in the airplane or set of airplanes.			X			X	Level 3 must be representative of a single set of airplanes, and must have navigation controls, displays, and instrumentation as set out in 14 CFR Part 91, § 91.33 for operation in accordance with instrument flight rules (IFR). Crewmember seats must afford the capability for the occupant to be able to achieve the design ''eye position'' for specific airplanes, or to approximate such a position for a generic set of airplanes.	For FTD purposes, the cockpit consists of all that space forward of a cross section of the fuselage at the most extreme aft setting of the pilots' seats including additional, required crewmember duty stations and those required bulkheads aft of the pilot seats.
b. The FTD must have equipment (*i.e.*, instruments, panels, systems, and controls) simulated sufficiently for the authorized training/checking events to be accomplished. The installed equipment, must be located in a spatially correct configuration, and may be in a cockpit or an open flight deck area. Actuation of this equipment must replicate the appropriate function in the airplane.		X		X	X		Level 2 must be representative of a single set of airplanes.	
c. Circuit breakers must function accurately when they are involved in operating procedures or malfunctions requiring or involving flight crew response.		X	X		X	X	Level 6 devices must have installed circuit breakers properly located in the FTD cockpit.	
3. Programming:								
a. The FTD must provide the proper effect of aerodynamic changes for the combinations of drag and thrust normally encountered in flight. This must include the effect of change in airplane attitude, thrust, drag, altitude, temperature, and configuration.		X	X		X	X	Levels 3 and 6 additionally require the effects of change in gross weight and center of gravity. Levels 2, 3, and 5 require only generic aerodynamic programming.	
b. The FTD must have the computer (analog or digital) capability (*i.e.*, capacity, accuracy, resolution, and dynamic response) needed to meet the qualification level sought.		X	X	X	X	X		

TABLE OF MINIMUM FLIGHT TRAINING DEVICE REQUIREMENTS INFORMATION—Continued

QPS Requirement	FTD level						Additional details	Notes
General FTD Standards	1	2	3	4	5	6		
c. The FTD hardware and programming must be updated within 6 months of any airplane modifications or data releases (or any such modification or data releases applicable to the set of airplanes) unless, with prior coordination, the NSPM authorizes otherwise.		X	X	X	X	X		
d. Relative responses of the cockpit instruments (and the visual and motion systems, if installed and training, testing, or checking credits are being sought) must be coupled closely to provide integrated sensory cues. The instruments (and the visual and motion systems, if installed, and training, testing, or checking credits are being sought) must respond to abrupt input at the pilot's position within the allotted time, but not before the time, when the airplane or set of airplanes would respond under the same conditions. If a visual system is installed and training, testing, or checking credits are sought, the visual scene changes from steady state disturbance must occur within the appropriate system dynamic response limit but not before the instrument response (and not before the motion system onset if a motion system is installed).		X	X		X	X	A demonstration is required and must simultaneously record: the analog output from the pilot's control column, wheel, and pedals; and the output signal to the pilot's attitude indicator. These recordings must be compared to airplane response data in the following configurations: takeoff, cruise, and approach or landing. The results must be recorded in the QTG. Additionally, if a visual system is installed and training, testing, or checking credits are sought, the output signal to the visual system display (including visual system analog delays must be recorded); and if a motion system is installed and training, testing, or checking credits are sought, the output from an accelerometer attached to the motion system platform located at an acceptable location near the pilots' seats is also required.	
4. Equipment Operation:								
a. All relevant instrument indications involved in the simulation of the airplane (or set of airplanes) must automatically respond to control movement or external disturbances to the simulated airplane or set of airplanes; *e.g.*, turbulence or winds.		X	X		X	X		
b. Navigation equipment must be installed and operate within the tolerances applicable for the airplane or set of airplanes.		X	X		X	X	Levels 2 and 5 need have only that navigation equipment necessary to fly an instrument approach. Levels 3 and 6 must also include communication equipment (inter-phone and air/ground) like that in the airplane, or set of airplanes, and, if appropriate to the operation being conducted, an oxygen mask microphone system.	

TABLE OF MINIMUM FLIGHT TRAINING DEVICE REQUIREMENTS INFORMATION—Continued

QPS Requirement	FTD level						Additional details	Notes
General FTD Standards	1	2	3	4	5	6		
c. Installed systems must simulate the applicable airplane (or set of airplanes) system operation, both on the ground and in flight. At least one airplane system must be represented. Systems must be operative to the extent that applicable normal, abnormal, and emergency operating procedures included in the sponsor's training programs can be accomplished.		X	X	X	X	X	Level 6 must simulate all applicable airplane flight, navigation, and systems operation. Level 3 must have flight and navigational controls, displays, and instrumentation for powered aircraft as set out in part 91, § 91.205 for IFR operation. Levels 2 and 5 must have functional flight and navigational controls, displays, and instrumentation.	
d. The lighting environment for panels and instruments must be sufficient for the operation being conducted.		X	X	X	X	X		
e. The FTD must provide control forces and control travel that correspond to the replicated airplane, or set of airplanes. Control forces must react in the same manner as in the airplane, or set of airplanes, under the same flight conditions.			X			X		
f. The FTD must provide control forces and control travel of sufficient precision to manually fly an instrument approach. The control forces must react in the same manner as in the airplane, or set of airplanes, under the same flight conditions.		X			X			
5. Instructor or Evaluator Facilities:								
a. In addition to the flight crewmember stations, suitable seating arrangements for an instructor/check airman and FAA Inspector must be available. These seats must provide adequate view of crewmember's panel(s).		X	X	X	X	X	....	These seats need not be a replica of an aircraft seat and may be as simple as an office chair placed in an appropriate position.
b. The FTD must have instructor controls that permit activation of normal, abnormal, and emergency conditions, as may be appropriate. Once activated, proper system operation must result from system management by the crew and not require input from the instructor controls.		X	X	X	X	X		
6. Motion System:								

TABLE OF MINIMUM FLIGHT TRAINING DEVICE REQUIREMENTS INFORMATION—Continued

QPS Requirement	FTD level						Additional details	Notes
General FTD Standards	1	2	3	4	5	6		
a. The FTD may have a motion system; if desired, although it is not required.		X	X	X	X	X	If installed, the motion system operation may not be distracting. The motion system standards set out in QPS FAA-S–120–40C for at least Level A simulators is acceptable.	
7. Visual System:								
a. The FTD may have a visual system; if desired, although it is not required. If a visual system is installed, it must meet the following criteria: (1) Single channel, uncollimated display is acceptable (2) Minimum field of view: 18° vertical/ 24° horizontal for the pilot flying (3) Maximum paralax error: 10° per pilot (4) Scene content may not be distracting (5) Minimum distance from the pilot's eye position to the surface of a direct view display may not be less than the distance to any front panel instrument (6) Minimum resolution of 5 arc-min. for both computed and displayed pixel size (7) Maximum latency or through-put must not exceed 300 milliseconds		X	X	X	X	X	A statement of capability is required. A demonstration of latency or through-put is required. Visual system standards set out in QPS FAA–S–120–40C, for at least Level A simulators is acceptable. However, if additional authorizations (training, testing, or checking credits) are sought that require the use of a visual system, these standards apply.	
8. Sound System:								
a. The FTD must simulate significant cockpit sounds resulting from pilot actions that correspond to those heard in the airplane.			X			X		

Attachment 2 to Appendix B to Part 60—Flight Training Device (FTD) Objective Tests

1. General

Begin QPS Requirements

a. Test Requirements

(1) The ground and flight tests required for qualification are listed in the following Table of Objective Tests. Computer generated FTD test results must be provided for each test. If a flight condition or operating condition is required for the test but which does not apply to the airplane being simulated or to the qualification level sought, it may be disregarded (for example: an engine out missed approach for a single-engine airplane; a maneuver using reverse thrust for an airplane without reverse thrust capability; etc.). Each test result is compared against Flight Test Data described in § 60.13, and Paragraph 9 of this attachment. (See paragraph 1.b, of this attachment for additional information.) Although use of a driver program designed to automatically accomplish the tests is authorized, each test must be able to be accomplished manually while recording all appropriate parameters. The results must be produced on a multi-channel recorder, line printer, or other appropriate recording device acceptable to the NSPM. Time histories are required unless otherwise indicated in the Table of Objective Tests. All results must be labeled using the tolerances and units given.

(2) The Table of Objective Tests 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 aerodynamic modeling and acquisition/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.

(3) Certain tests included in this appendix must be supported with a Statement of Compliance and Capability (SOC). In the following tabular listing of FTD tests, requirements for SOC's are indicated in the ''Test Details'' column.

(4) When operational or engineering judgment is used in making assessments for flight test data applications for FTD 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 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.

(5) It is not sufficient, nor is it acceptable, to program the FTD so that the aerodynamic modeling is correct only at the validation test points. Unless noted otherwise, tests must represent airplane performance and handling qualities at normal operating weights and centers of gravity (CG). 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 Levels 3 and 6 are expected to be indicative of the device's performance and handling qualities throughout the following:

(a) the airplane weight and CG envelope;

(b) the operational envelope; and

(c) varying atmospheric ambient and environmental conditions— including the extremes authorized for the respective airplane or set of airplanes.

(6) 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 ±5 pounds (2.2 daN) in 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 clearly annotated as to indicated, calibrated, etc., and like values used for comparison.

(7) The QTG provided by the sponsor must describe clearly and distinctly how the FTD will be set up and operated for each test. Overall integrated testing of the FTD must be accomplished to assure that the total FTD system meets the prescribed standards; i.e., it is not acceptable to test only each FTD subsystem independently. A manual test procedure with explicit and detailed steps for completion of each test must also be provided.

(8) In those cases where the objective test results authorize a ''snapshot'' result in lieu of a time-history result, the sponsor must ensure that a steady state condition exists from 5 seconds prior to, through 2 seconds after, the instant of time captured by the ''snapshot.''

(9) For previously qualified FTDs, the tests and tolerances of this appendix may be used in subsequent recurrent evaluations for any given test providing the sponsor has submitted a proposed MQTG revision to the NSPM and has received NSPM approval.

(10) FTDs are evaluated and qualified with an engine model simulating the airplane manufacturer's flight test engine. For qualification of alternate engine models (either variations of the flight test engines or other manufacturer's engines) additional FTD tests with the alternate engine models are required. Where thrust is different by more than 5% from the flight test engine, flight test data from an airplane equipped with the alternate engine is required. Where the airplane manufacturer certifies that the only impact on the FTD model is thrust, and that other variables related to the alternate engine (such as drag and thrust vector) are unchanged or are insignificantly changed, additional FTD tests may be run with the same initial conditions using the thrust from the flight test data as a driven parameter for the alternate engine model.

(11) 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.

End QPS Requirements

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b. Discussion

Begin Information

(1) If relevant winds are present in the objective data, the wind vector (magnitude and direction) should be clearly noted as part of the data presentation, expressed in conventional terminology, and related to the runway being used for the test.

End Information

TABLE OF OBJECTIVE TESTS

QPS requirement										Info notes
Test	Tolerance	Flight conditions	Flight training device level						Test details	
			1	2	3	4	5	6		
2. Performance a. Takeoff										

TABLE OF OBJECTIVE TESTS—Continued

QPS requirement										Info notes
Test	Tolerance	Flight conditions	Flight training device level						Test details	
			1	2	3	4	5	6		
(1) Ground Acceleration Time	±5% Time or ±1 Second	Ground/Takeoff			X			X	Record acceleration time for a minimum of 80% of the total segment from brake release to V_r. Preliminary aircraft certification data may be used.	
b. Climb										
(1) Normal Climb	±3 Kts Airspeed, ±5% or ±100 FPM (0.5 Meters/Sec) Climb Rate	All Engines Operating		X	X		X	X	Record results at nominal climb speed and at nominal altitude. Manufacturer's gross climb gradient may be used for flight test data. May be a snapshot test result.	
c. Ground Deceleration										
(1) Deceleration time, using manual application of wheel Brakes; no reverse thrust	±5% time or ±1 Second	Landing Dry Runway			X			X	Record time for at least 80% of the segment from initiation of the Rejected Takeoff to full stop.	
(2) Deceleration time, using reverse thrust and no wheel brakes	±5% time or ±1 Second	Landing Dry Runway			X			X	Record time for at least 80% of the segment from initiation of Rejected Takeoff to full stop.	
d. Engines										
(1) Acceleration	±10% time	Approach or Landing		X	X		X	X	Record engine power (N_1, N_2, EPR, Torque, etc.) from idle to go-around power for a rapid (slam) throttle movement. Tolerance of ±1 second authorized for Levels 2, 3, and 5.	
(2) Deceleration	±10% Time	Ground/Takeoff		X	X		X	X	Record engine power (N_1, N_2, EPR, Torque, etc.) from Max T/O power to 90% decay of Max T/O power for a rapid (slam) throttle movement. Tolerance of ±1% second authorized for Levels 2, 3, and 5.	
3. Handling Qualities										
Note: For FTDs requiring Static or Dynamic tests at the controls, special test fixtures will not be required during initial or upgrade evaluations if the sponsor's QTG/MQTG shows both test fixture results and the result of an alternative method during the initial or upgrade evaluation would then satisfy this test requirement. Contact the NSPM for clarification of any issue regarding airplanes with reversible controls.										
a. Static Control Checks										
(1)(a) Column Position vs. Force and Surface Position Calibration.	±2 lbs. (0.9daN) Breakout, ±5 lbs. (2.2 daN) or ±10% Force, ±2° Elevator.	Ground						X	Record results for an uninterrupted control sweep to the stops. (CCA: Position vs. force not required if cockpit controller is installed in the FTD.).	
(1)(b) Column Position vs. Force.	±2 lbs. (0.9daN) Breakout, ±5 lbs. (2.2 daN) or ±10% Force.	Ground		X	X				Record results for an uninterrupted control sweep to the stops. (CCA: Position vs. force not required if cockpit controller is installed in the FTD.).	

TABLE OF OBJECTIVE TESTS—Continued

QPS requirement										Info notes
Test	Tolerance	Flight conditions	Flight training device level						Test details	
			1	2	3	4	5	6		
(2)(a) Wheel Position vs. Force and Surface Position Calibration.	±2 lbs. (0.9daN) Breakout, ±3 lbs. (1.34 daN) or ±10% Force, ±1° Aileron, ±27° Spoiler.	Ground						X	Record results for an uninterrupted control sweep to the stops. (CCA: Position vs. force not required if cockpit controller is installed in the FTD.).	
(2)(b) Wheel Position vs. Force.	±2 lbs. (0.9daN) Breakout, ±3 lbs. (1.3 daN) or ±10% Force.	Ground		X	X		X		Record results for an uninterrupted control sweep to the stops. (CCA: Position vs. force not required if cockpit controller is installed in the FTD.).	
(3)(a) Pedal Position vs. Force and Surface Position Calibration.	±5 lbs. (2.2 daN) Breakout, ±5 lbs. (2.2 daN) or ±10% Force, ±2° Rudder.	Ground						X	Record results for an uninterrupted control sweep to the stops.	
(3)(b) Pedal Position vs. Force.	±5 lbs. (2.2 daN) Breakout, ±5 lbs. (2.2 daN) or ±10% Force.	Ground		X	X		X		Record results for an uninterrupted control sweep to the stops.	
(4) Nosewheel Steering Force.	±2 lbs. (0.9 daN) Breakout, ±3 lbs. (1.3 daN) or ±10% Force.	Ground			X			X		
(5) Rudder Pedal Steering Calibration.	±2° Noswheel Angle	Ground			X			X		
(6) Pitch Trim Calibration Indicator vs. Computed.	±0.5° of Computed Trim Angle.	Ground						X		
(7) Alignment of Power Lever (or Cross Shaft Angle) vs Selected Engine Parameter (e.g., EPR, N1, Torque, Manifold Pressure, etc.).	±5° of Power Lever Angle or Cross Shaft Angle or Equivalent.	Ground						X	Requires recording for all engines. No simulator throttle position may be more than 5° (in either direction) from the airplane throttle position. Also, no simulator throttle position may differ from any other simulator throttle position by more than 5°. Where power levers do not have angular travel, a tolerance of ± 0.8 in (2 cm) applies. In the case of propeller powered airplanes, if a propeller lever is present, it must also be checked. May be a serious of snapshot test results.	
(8) Brake Pedal Position vs. Force.	±2° Pedal Position, ±5 lbs. (2.2 daN) or 10% Force.	Ground			X			X	Two data points are required (zero and maximum deflection). Computer output results may be used to show compliance.	
b. Longitudinal										
(1) Power Change Force	±5 lbs. (2.2 daN) or ±20% Force.	Cruise or Approach		X	X		X	X	May be a series of snapshot test results. Power change dynamics will be accepted. (CCA: Test in Normal and Non-normal control state).	
(2) Flap/slat Change Force	±5 lbs. (2.2 daN) or ±20% Force.	Takeoff and Approach		X	X		X	X	May be a series of snapshot test results. Flap change dynamics will be accepted. (CCA: Test in Normal and Non-normal control state).	

TABLE OF OBJECTIVE TESTS—Continued

QPS requirement										Info notes
Test	Tolerance	Flight conditions	Flight training device level						Test details	
			1	2	3	4	5	6		
(3) Gear Change Force	±5 lbs. (2.2 daN) or ±20% Force.	Takeoff and Approach		X	X		X	X	May be a series of snapshot test results. Gear change dynamics will be accepted. (CCA: Test in Normal and Non-normal control state).	
(4) Gear and Flap Operating Times.	±3 Seconds or ±10% of Time.	Takeoff and Approach		X	X		X	X		
(5) Longitudinal Trim	±1° Pitch Control (Stab and Elevator); ±1° Pitch Angle, ±2% Net Thrust or equivalent in Cruise; ±5% Net Thrust, or equivalent in Approach and Landing.	Cruise, Approach, Landing		X	X		X	X	May be a series of snapshot test results. Levels 2,3, and 5 may use equivalent stick and trim controllers in lieu of stabilizer and elevator. (CCA: Test in Normal and Non-normal control state).	
(6) Longitudinal Maneuvering Stability (Stick Force/g).	±5 lbs. (2.2. daN) or ±10% Column Force or Equivalent Surface position.	Cruise, Approach, Landing						X	May be a series of snapshot test results. Force or surface deflection must be in the correct direction. (CCA: Test in Normal and Non-normal control state).	
(7) Longitudinal Static Stability.	±5 lbs. (2.2 daN) or ±10% Column Force or Equivalent Surface position.	Approach		X	X		X	X	May be a series of snapshot test results. Levels 2,3, and 5 must exhibit positive static stability, but need not comply with the numerical tolerance. (CCA: Test Normal and Non-normal control state).	
(8) Stall Warning (actuation of stall warning device).	±3 Kts Airspeed, ±2° Bank	Second Segment Climb and Approach or Landing.		X	X		X	X		
(9)(a) Phugoid Dynamics	±10% of Period, ±10% of Time to 1/2 Amplitude or ±.02 of Damping Ratio.	Cruise						X	Results must include whichever is less of the following: Three (3) full cycles (6 overshoots after the input is completed), or the number of cycles sufficient to determine time to ½ or double amplitude. (CCA: Test in Normal and Non-normal control state.).	
(9)(b) Phugoid Dynamics	±10% of Period with Representative Damping.	Cruise		X	X		X		CCA: Test in Normal and Non-normal control state.	
(10) Short Period Dynamics	±1.5° Pitch or ±2°/sec Pitch Rate, ±0.10g Normal Acceleration.	Cruise						X	CCA: Test in Normal and Non-normal control state.	
c. Lateral Directional										
(1) Roll Response	±10% or ±2°/sec Roll Rate	Cruise and Approach or Landing.		X	X		X	X		
(2) Response to Roll Controller Step Input.	±10% or ±2°/sec Roll Rate	Approach or Landing			X			X	CCA: Test in Normal and Non-normal control state.	
(3)(a) Spiral Stability	Correct Trend	Cruise		X			X		CCA: Test in Normal and Non-normal control state.	
(3)(b) Spiral Stability	Correct Trend, and ±3° of Bank Angle or ±10% at 20 sec.	Cruise			X			X	Data averaged from direction may be used. (CCA: Test in Normal and Non-normal control state.).	

TABLE OF OBJECTIVE TESTS—Continued

QPS requirement											Info notes
Test	Tolerance	Flight conditions	Flight training device level						Test details		
			1	2	3	4	5	6			
(4)(a) Rudder Response	±2°/sec, or ±10% Yaw Rate or ±10% Rate of Heading Change for small pitch attitudes.	Approach or Landing						X	CCA: Test in Normal and Non-normal control state. May be deleted if rudder input and response is shown in Dutch roll test.		
(4)(b) Rudder Response	Yaw Rate ±2°/sec, Bank Angle ±3°.	Approach or Landing		X	X		X		May be roll response to a given rudder deflection. (CCA: Test in Normal and Non-normal control state.).		
(5)(a) Dutch Roll, Yaw Damper Off.	(1) ±10% of Period (2a)±10% of Time to ½ Amplitude or Double Amplitude, or (2b) ±.02 of Damping Ratio.	Cruise, and Approach or Landing.						X	Record results for at least 6 cycles with stability augmentation off. (CCA: Test in Normal and Non-normal control state.).		
(5)(b) Dutch Roll, Yaw Damper Off.	±10% of Period With Correct Trend and Number of Cycles.	Cruise, and Approach or Landing.			X				CCA: Test in Normal and Non-normal control state.		
(6) Steady State Sideslip ...	For given rudder position; ±2° Bank, ±1° Sideslip, ±10% or ±2° Aileron, ±10% or ±5° Spoiler or Equivalent Wheel Position or Force.	Approach or Landing		X	X		X	X	May be a series of snapshot test results. Propeller driven airplanes must test in each direction.		

4. Control Dynamics

Begin Information

a. The characteristics of an airplane flight control system have a major effect on the handling qualities. A significant consideration in pilot acceptability of an airplane is the ''feel'' provided through the cockpit controls. Considerable effort is expended on airplane feel system design in order to deliver a system with which pilots will be comfortable and consider the airplane desirable to fly. In order for a simulator to be representative, it too must present the pilot with the proper feel; that of the respective airplane. Aircraft control feel dynamics shall duplicate the airplane simulated. This shall be determined by comparing a recording of the control feel dynamics of the simulator to airplane measurements in the takeoff, cruise, and landing configuration.''

b. 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 only being able to estimate true inputs and responses. Therefore, it is imperative that the best possible data be collected since close matching of the simulator control loading system to the airplane systems is essential. The required control feel dynamic tests are described in 2.b. of this attachment. For initial and upgrade evaluations, it is required that control dynamic characteristics be measured at and recorded directly from the cockpit controls. This procedure is usually accomplished by measuring the free response of the controls using a step or pulse input to excite the system. The procedure must be accomplished in takeoff, cruise, and landing flight conditions and configurations.

c. 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. If either or both considerations apply, engineering validation or airplane manufacturer rationale must be submitted as justification for ground tests or for eliminating a configuration. For simulators requiring static and dynamic tests at the controls, special test fixtures will not be required during initial and upgrade evaluations if the sponsor's QTG shows both test fixture results and the results of an alternative approach, such as computer plots that were produced concurrently and show satisfactory agreement. Repeat of the alternative method during the initial evaluation would then satisfy this test requirement.

(1) Control Dynamics Evaluations. The dynamic properties of control systems are often stated in terms of frequency, damping, and a number of other classical measurements that can be found in texts on control systems. In order to establish a consistent means of validating test results for simulator control loading, criteria are needed that will clearly define the interpretation of the measurements and the tolerances to be applied. Criteria are needed for both the underdamped system and the overdamped system, including the critically damped case. 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 is not readily measured from a response time history. Therefore, some other measurement must be used.

(2) Tests to verify that control feel dynamics represent the airplane must show that the dynamic damping cycles (free response of the control) match that of the airplane within specified tolerances. The method of evaluating the response and the tolerance to be applied are described below for the underdamped and critically damped cases.

d. Tolerances. (1) Underdamped Response. (a) 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 nonuniform 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.

(b) The damping tolerance will be applied to overshoots on an individual basis. Care must be taken when applying the tolerance to small overshoots since the significance of such overshoots becomes questionable. Only those overshoots larger than 5 percent of the total initial displacement will be considered significant. The residual band, labeled $T(A_d)$ on Figure 1 of this attachment is ±5 percent of the initial displacement amplitude A_d from the steady state value of the oscillation. Oscillations within the residual band are considered insignificant. When comparing simulator data to airplane data, the process would begin by overlaying or aligning the simulator and airplane steady state values and then comparing amplitudes of oscillation peaks, the time of the first zero crossing, and individual periods of oscillation. To be satisfactory, the simulator must show the same number of significant overshoots to within one when compared against the airplane data. This procedure for evaluating the response is illustrated in Figure 1 of this attachment.

(2) Critically Damped and Overdamped Response. Due to the nature of critically damped responses (no overshoots), the time to reach 90 percent of the steady state (neutral point) value must be the same as the airplane within ±10 percent. The simulator response must be critically damped also. Figure 2 of this attachment illustrates the procedure.

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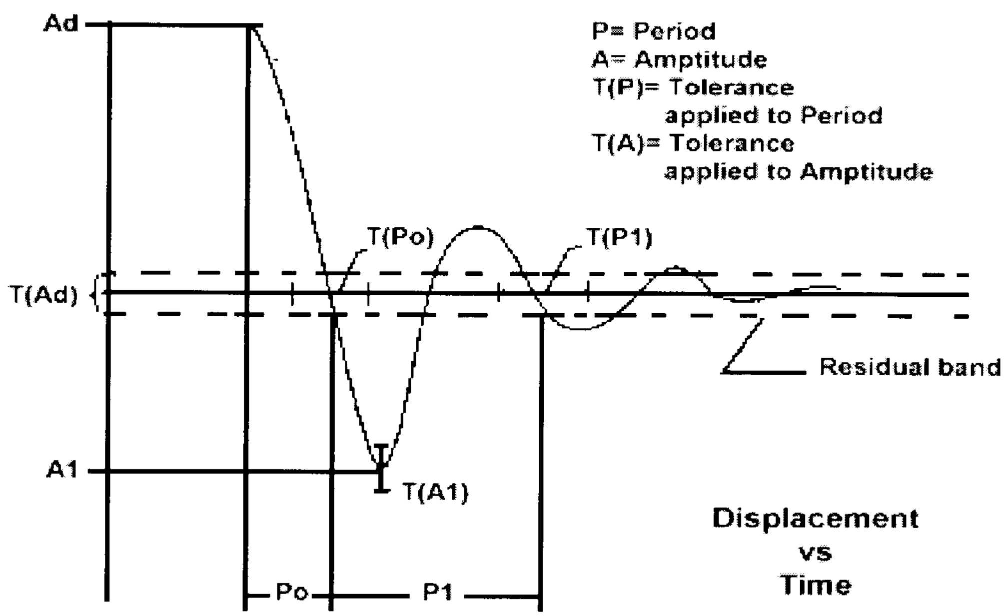
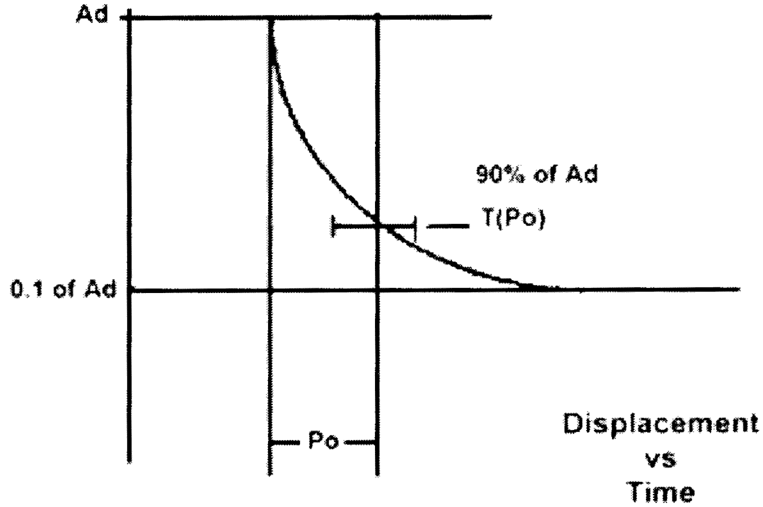


ATTACHMENT 2 TO APPENDIX B TO PART 60—

FIGURE 1. UNDER-DAMPED STEP RESPONSE



ATTACHMENT 2 TO APPENDIX B TO PART 60—

FIGURE 2. CRITICALLY-DAMPED STEP RESPONSE

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Begin Information

(3)(a) The following summarizes the tolerances, T, for an illustration of the referenced measurements (See Figures 1 and 2 of this attachment)

$T(P_0)$ ±10% of P_0
$T(P_1)$ ±20% of P_1
T(A) ±10% of A_1, ±20% of Subsequent Peaks
$T(A_d)$ ±10% of A_d = Residual Band
Overshoots ±1

(b) In the event the number of cycles completed outside of the residual band, and thereby significant, exceeds the number depicted in figure 1 of this attachment, the following tolerances (T) will apply:

$T(P_n)$ ±10%(n+1)% of P_n, where "n" is the next in sequence.

e. Alternative Method for Control Dynamics. (1) An alternative means for dealing with control dynamics applies to airplanes with hydraulically powered flight controls and artificial feel systems. Instead of free response measurements, the system would be validated by measurements of control force and rate of movement.

(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 shall 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 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.

f. Tolerances.

(1) Static Test—Items 2.a.(1) (2) and (3) of this appendix.

(2) Dynamic Test—2 lb. or 10 percent on dynamic increment above static test.

g. The FAA 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 FAA finds that alternative methods do not result in satisfactory simulator performance, then more conventionally accepted methods must be used.

End Information

5. Alternative Objective Data for FTD Levels 2, 3, and 5

Begin QPS Requirements

a. This paragraph 5 (including the following tables) is relevant only to FTD Levels 2, 3, and 5 and is provided due to the fact that these levels are required to perform and handle similarly to a set of airplanes having similar performance (normal airspeed/altitude operating envelope), that have similar handling characteristics, and have the same number and type of propulsion systems (engines).

b. The following tables reflect the performance range typical for the stated set of airplanes and may be used without having to acquire flight test data or gather validation data from any other source. However, if the performance of the device does not fall within the established range (according to the following tables) for a specific table entry, and the sponsor has airplane flight test data, acceptable to the NSPM, that matches the performance of the device within the tolerances established in the Table of Objective Tests, this flight test data may be used for that specific table entry requirement. The reader is reminded that Level 3 devices require testing in more areas than Level 2 and Level 5 devices. Therefore, as the following tables contain information for all three FTD levels, some of the data in these tables may not be pertinent to a Level 2 or Level 5 FTD.

c. The following applies to those wishing to pursue this alternative approach:

(1) The sponsor will submit a complete QTG including the following:

(a) If this alternate source of data method is used, recordings that demonstrate that the performance of the FTD is within the allowable performance range.

(b) Results from the objective tests appropriate to the level of qualification sought.

(2) The QTG test results must include all appropriate parameters for which tolerances are established in the Table of Objective Tests, and 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 would have an impact on the conduct of the test.

(3) One reviewed and accepted by the NSPM, these test results are the validation

data against which the initial and all subsequent recurrent evaluations will be compared. These subsequent evaluations will use the tolerances listed in the Table of Objective Tests.

(4) Subjective testing of the device must be performed to determine that the device performs and handles acceptably like an airplane within the appropriate set of airplanes.

End QPS Requirements

Begin Information

d. The alternative source data contained in the following tables have been derived from a consensus of aviation professionals, including simulator and flight training device manufacturers; pilots and instructors familiar with the various sets of airplanes, and airplane manufacturer's representatives for airplanes fitting the appropriate set of airplanes.

e. The reader is encouraged to consult the Airplane Flight Simulator Evaluation Handbook, Volumes I and II, published by the Royal Aeronautical Society, London, UK, in February 1995 and July 1996, respectively, and FAA Advisory Circulars (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, for references and examples regarding flight testing requirements and techniques.

End Information

TABLE OF ALTERNATIVE SOURCE DATA FTD LEVELS 2, 3, AND 5

[Small, Single Engine (Reciprocating) Airplane]

QPS REQUIREMENT	
Applicable Test and Test Number	Authorized Performance Range
2. Performance	
a. Takeoff	
(1) Ground acceleration time; brake release to liftoff Speed	20–30 Seconds.
b. Climb	
(1) Normal climb with nominal gross weight, at best rate-of-climb airspeed.	Climb rate = 500–1200 fpm (2.5–6 m/sec).
c. Ground Deceleration	
(1) Deceleration time from 60 knots to zero; with a nominal gross weight; using wheel brakes on a dry runway.	5–15 Seconds.
d. Engines	
(1) Acceleration; idle to takeoff power	2–4 Seconds.
(2) Deceleration; takeoff power to idle	2–4 Seconds.
3. Handling Qualities	
a. Static Control Checks	
(1)(b) Column position vs. force	Plot of Column Position vs. Force must fall within the shaded areas shown in Figure 3 of this attachment (Small, Single Engine Airplanes).
(2)(b) Wheel position vs. force	Plot of Wheel Position vs. Force must fall within the shaded areas shown in Figure 3a of this attachment (Small, Single Engine Airplanes).
(3)(b) Pedal position vs. force	Plot of Rudder Pedal Position vs. Force must fall within the shaded areas shown in Figure 3b of this attachment (Small, Single Engine Airplanes).
(4) Nosewheel steering force	Plot of Rudder Pedal Position vs. Force must fall within the shaded areas shown in Figure 3b of this attachment (Small, Single Engine Airplanes).
(5) Rudder pedal steering calibration with full rudder pedal travel	10–30 degrees of nosewheel angle, both sides of neutral.
(8) Brake pedal position vs. force; at maximum pedal deflection	30–100 lbs (13.2–44 daN) of force.
b. Longitudinal	
(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.	(a) 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.	(b) 5–15 lbs (2.2–6.6 daN) of force (Push).
(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.	(a) 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.	(b) 5–15 lbs (2.2–6.6 daN) of force (Push).
(3) Gear change force	

TABLE OF ALTERNATIVE SOURCE DATA FTD LEVELS 2, 3, AND 5—Continued

[Small, Single Engine (Reciprocating) Airplane]

QPS REQUIREMENT	
Applicable Test and Test Number	Authorized Performance Range
(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.	(a) 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.	(b) 2–12 lbs (0.88–5.3 daN) of force (Push).
(4) Gear and flap operating times	
(a) Extend gear	(a) 2–12 seconds.
(b) Retract gear	(b) 2–12 seconds.
(c) Extend flaps, zero to 50% travel	(c) 3–13 seconds.
(d) Retract flaps, 50% travel to zero	(d) 3–13 seconds.
(5) Longitudinal trim	Must be able to trim longitudinal stick force to ''zero'' in each of the following configurations: cruise; approach; and landing.
(7) Longitudinal static stability	Must exhibit positive static stability.
(8) Stall warning (actuation of stall warning device) with nominal gross weight; wings level; and a deceleration rate of approximately one (1) knot per second.	
(a) Landing configuration	(a) 40–60 knots; ± 5° of bank.
(b) Clean configuration	(b) Landing configuration speed + 10–20 percent.
(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.
c. Lateral Directional	
(1) Roll response	
Roll rate must be measured through at least 30 degrees of roll. Aileron control must be deflected 50 percent of maximum travel.	Must have a roll rate of 6–40 degrees/second.
(2) Response to roll controller step input	
Trim for straight and level flight at nominal gross weight and approach airspeed. Roll into a 30 degree bank turn and stabilize. When ready, input a 50 percent aileron control opposite to the direction of turn. When reaching zero bank angle, rapidly neutralize the aileron control and release. Record the response from at least 2 seconds prior to the initiation of control input opposite to the direction of turn until at least 20 seconds after neutralization of the controls.	Roll rate must decrease to not more than 10 percent of the roll rate achieved, within 1–3 seconds of control release.
(3)(a) and (b) Spiral stability	
Cruise configuration and normal cruise airspeed. Establish a 20–30 degree bank. When stabilized, neutralize the aileron control and release. Must be completed in both directions of turn.	Initial bank angle (± 5 degrees) after 20 seconds.
(4)(b) Rudder response	
Use 50 percent of maximum rudder deflection	6–12 degrees/second yaw rate.
Applicable to approach or landing configuration	
(5)(b) Dutch roll, yaw damper off	A period of 2–5 seconds; and ½–2 cycles.
Applicable to cruise and approach configurations	
(6) Steady state sideslip	2–10 degrees of bank; 4–10 degrees of sideslip; and
Use 50 percent rudder deflection	2–10 degrees of aileron.
Applicable to approach and landing configurations	
4. Cockpit Instrument Response.	
Instrument systems response to an abrupt pilot controller input. One test is required in each axis (pitch, roll, and yaw).	300 milliseconds or less.

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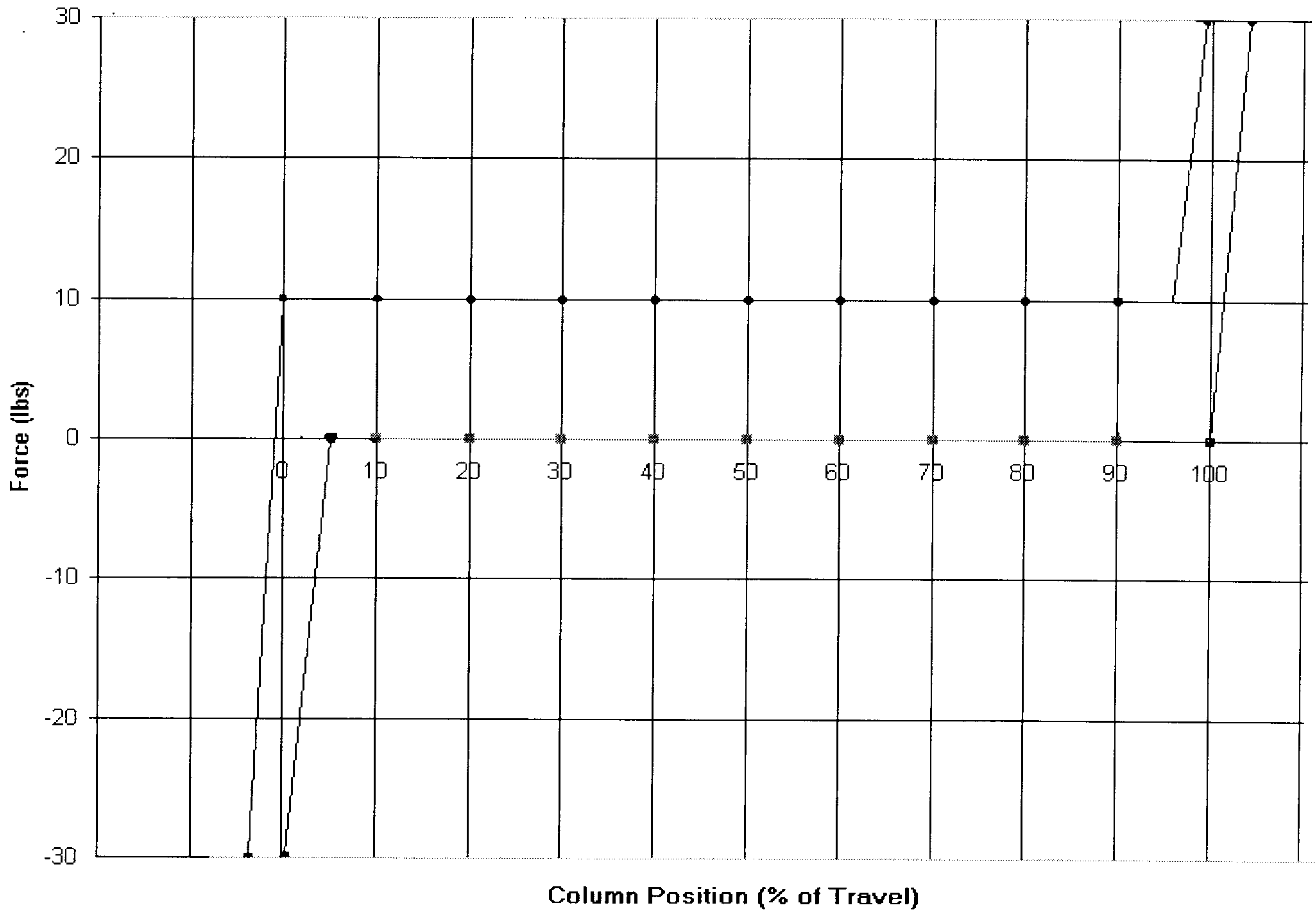
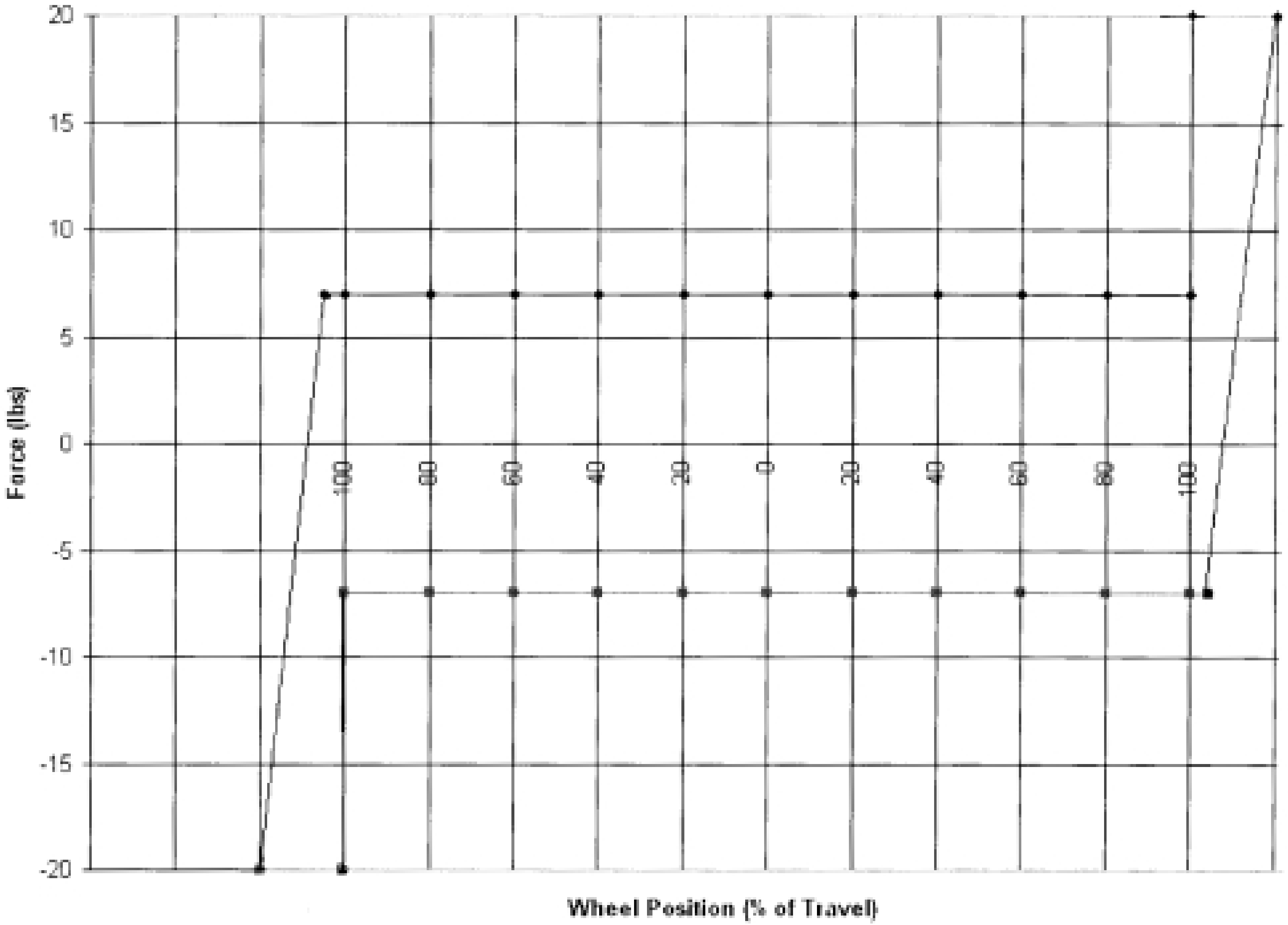


ATTACHMENT 2 TO APPENDIX B TO PART 60—

FIGURE 3. SMALL SINGLE ENGINE (RECIPROCATING) AIRPLANE

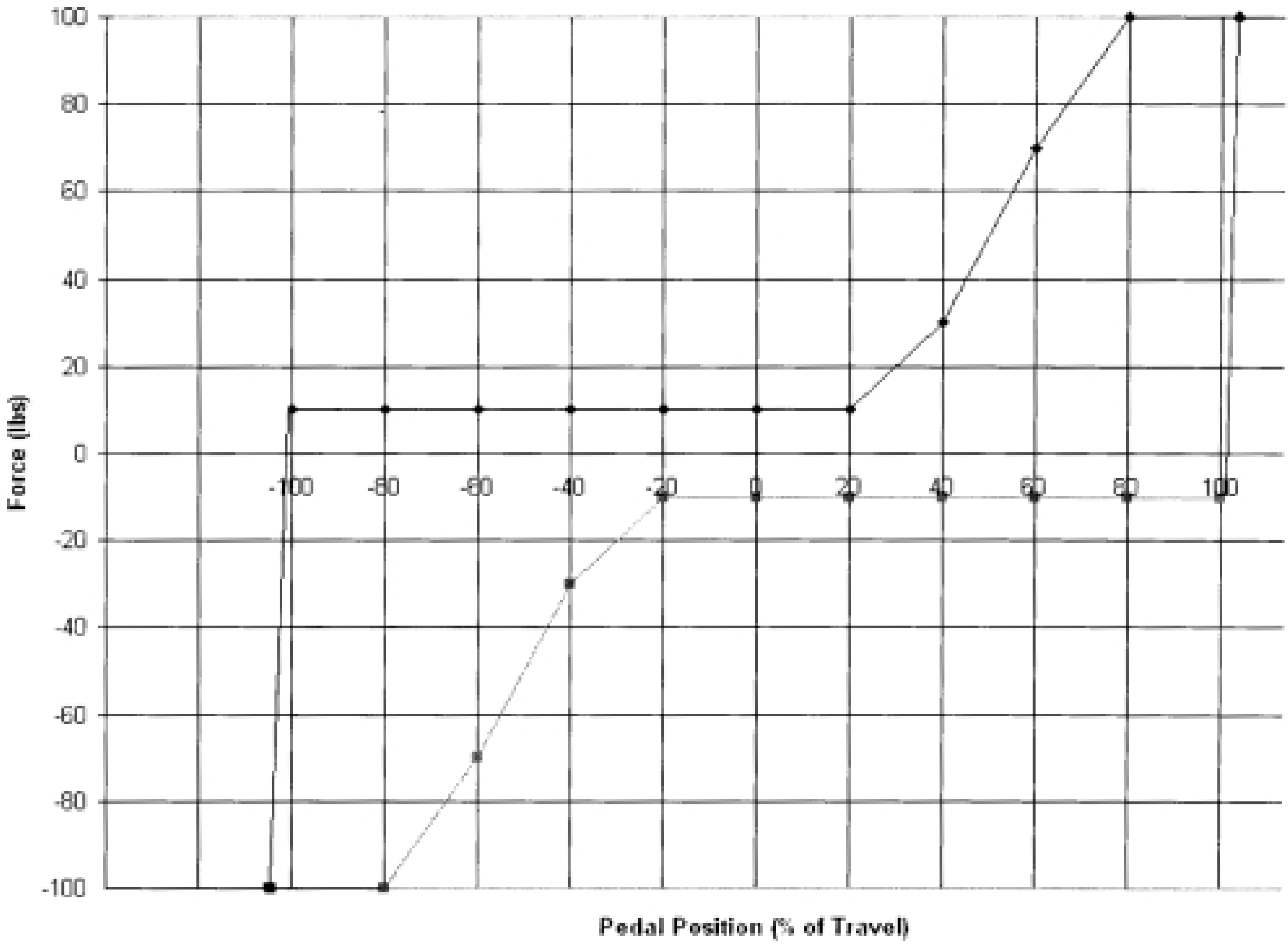
COLUMN POSITION VS. FORCE



ATTACHMENT 2 TO APPENDIX B TO PART 60—

FIGURE 3a. SMALL, SINGLE ENGINE (RECIPROCATING) AIRPLANE

WHEEL POSITION VS. FORCE



ATTACHMENT 2 TO APPENDIX B TO PART 60—

FIGURE 3b. SMALL, SINGLE ENGINE (RECIPROCATING) AIRPLANE

RUDDER PEDAL POSITION VS. FORCE

BILLING CODE 4910–13–C

TABLE OF ALTERNATIVE SOURCE DATA FTD LEVELS 2, 3, AND 5

[Small, Multi-Engine (Reciprocating) Airplane]

QPS REQUIREMENT	
Applicable Test and Test Number	Authorized Performance Range
2. Performance	
a. Takeoff	
(1) Ground acceleration time; brake release to liftoff speed	20–230 Seconds.
b. Climb	
(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).
c. Ground Deceleration	
(1) Deceleration time from 80 knots to zero; with a nominal gross weight; using wheel brakes on a dry runway.	10–20 Seconds.
d. Engines	
(1) Acceleration; idle to takeoff power	2–5 Seconds.
(2) Deceleration; takeoff power to idle	2–5 Seconds.

TABLE OF ALTERNATIVE SOURCE DATA FTD LEVELS 2, 3, AND 5—Continued

[Small, Multi-Engine (Reciprocating) Airplane]

QPS REQUIREMENT	
Applicable Test and Test Number	Authorized Performance Range
3. Handling Qualities	
a. Static Control Checks	
(1)(b) Column position vs. force	Plot of Column Position vs. Force must fall within the shaded areas shown in Figure 4, page 29 (Small, Multi-Engine Airplanes).
(2)(b) Wheel position vs. force	Plot of Wheel Position vs. Force must fall within the shaded areas shown in Figure 5, page 30 (Small, Multi-Engine Airplanes).
(3)(b) Pedal position vs. force	Plot of Rudder Pedal Position vs. Force must fall within the shaded areas shown in Figure 6, page 31 (Small, Multi-Engine Airplanes).
(4) Nosewheel steering force	Plot of Rudder Pedal Position vs. Force must fall within the shaded areas shown in Figure 6, page 31 (Small, Multi-Engine Airplanes).
(5) Rudder pedal steering calibration with full rudder pedal travel	10–30 degrees of nosewheel angle, both side of neutral.
(8) Brake pedal position vs. force; at maximum pedal deflection	50–150 lbs (22–66 daN) of force.
b. Longitudinal	
(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.	(a) 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.	(b) 5–15 lbs (2.2–6.6 daN) or force (Push).
(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.	(1) 5–15lbs (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 (fully retracted). After stabilized, record stick force necessary to maintain original airspeed.	(b) 5–15 lbs (2.2–6.6 daN) of force (Push).
(3) 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.	(a) 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.	(b) 2–12 lbs (0.88–5.3 daN) of force (Push).
(4) Gear and flap operating times.	
(a) Extend gear	(a) 2–12 seconds.
(b) Retract gear	(b) 2–12 seconds.
(c) Extend flaps, zero to 50% travel	(c) 3–13 seconds.
(d) Retract flaps, 50% travel to zero	(d) 3–13 seconds.
(5) Longitudinal trim	Must be able to trim longitudinal stick force to "zero" in each of the following configurations: (a) cruise; (b) approach; and (c) landing.
(7) Longitudinal static stability	Must exhibit positive static stability.
(8) Stall warning (actuation of stall warning device) with nominal gross weight; wings level; clean configuration, and a deceleration rate of approximately one (1) knot per second.	(a) 60–90 knots; ±5 degrees of bank.
(a) Landing configuration	(b) Landing confirguration speed, + 10–20 percent.
(b) Clean configuration.	
(9)(b) Phugoid dynamics	(a) Must have a phugoid with a period of 30–60 seconds. (b) May not reach ½ or double amplitude in less than 2 cycles.
c. Lateral Directional	
(1) Roll response	

TABLE OF ALTERNATIVE SOURCE DATA FTD LEVELS 2, 3, AND 5—Continued

[Small, Multi-Engine (Reciprocating) Airplane]

QPS REQUIREMENT	
Applicable Test and Test Number	Authorized Performance Range
Roll rate must be measured through at least 30 degrees of roll. Aileron control must be deflected 50 percent of maximum travel.	Must have a roll rate of 6–40 degrees/second.
(2) Response to roll controller step input	
Trim for straight and level flight at nominal gross weight and approach airspeed. Roll into a 30 degree bank turn and stabilize. When ready, input a 50 percent aileron control opposite to the direction of turn. When reaching zero bank angle, rapidly neutralize the aileron control and release. Record the response from at least 2 seconds prior to the initiation of control input opposite to the direction of turn until at least 20 seconds after neutralization of the controls.	Roll rate must decrease to not more than 10 percent of the roll rate achieved, within 1–3 seconds of control release.
(3)(a) and (b) Spiral stability	
Cruise configuration and normal cruise airspeed. Establish a 20–30 degree bank. When stabilized, neutralize the aileron control and release. Must be completed in both directions of turn.	Initial bank angle (±5 degrees) after 20 seconds.
(4)(b) Rudder response	
Use 50 percent of maximum rudder deflection	6–12 degrees/second yaw rate.
Applicable to approach or landing configuration	
(5)(b) Dutch roll, yaw damper off	(a) A period of 2–5 seconds; and ½–2 cycles.
Applicable to cruise and approach configurations	
(6) Steady state sideslip	2–10 degrees of bank; 4–10 degrees of sideslip; and
Use 50 percent rudder deflection; Applicable to approach and landing configurations.	2–10 degrees of aileron.
4. Cockpit Instrument Response	
Instrument systems response to an abrupt pilot controller input. One test is required to each axis (pitch, roll, and yaw).	300 milliseconds or less.

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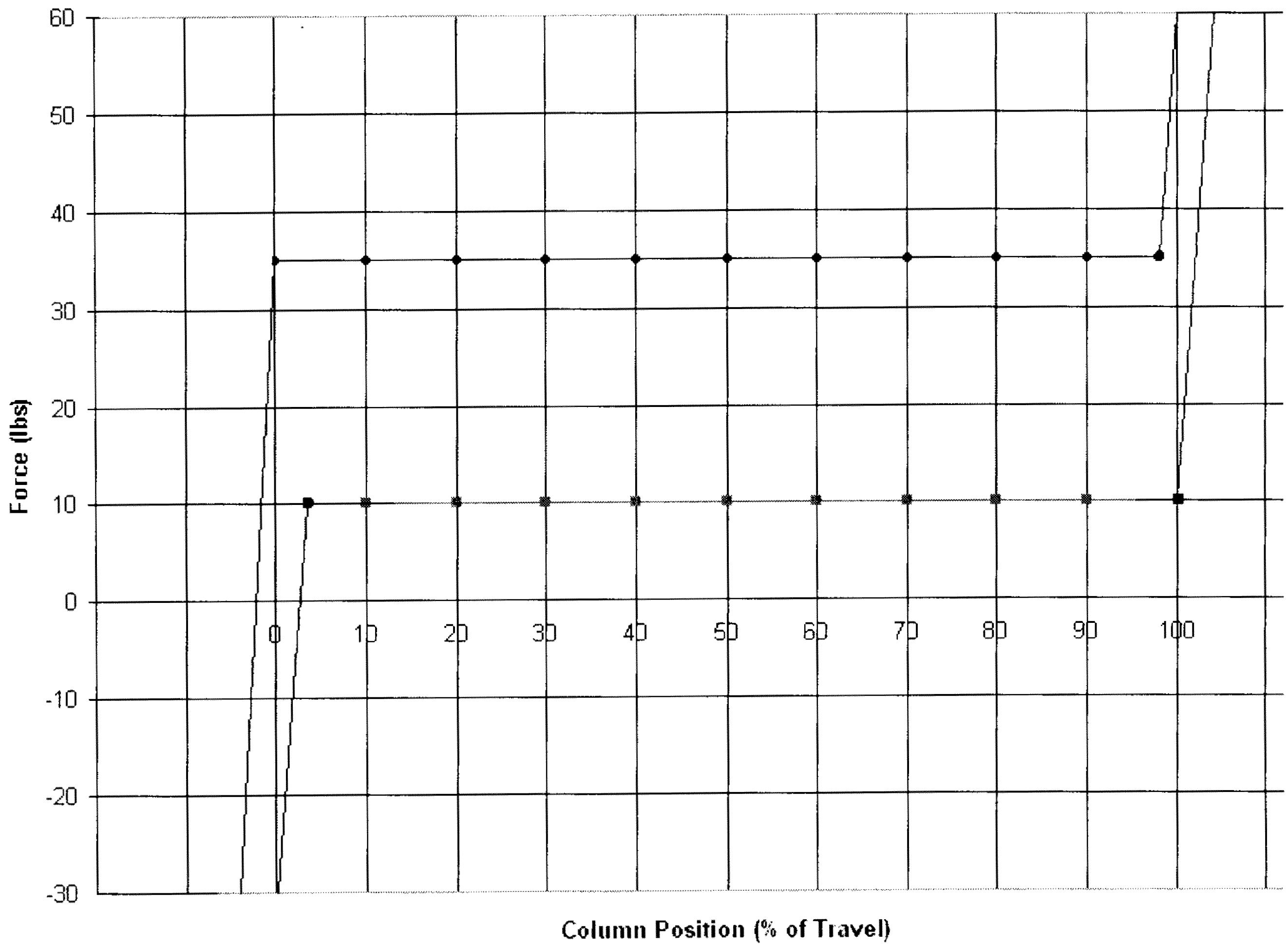
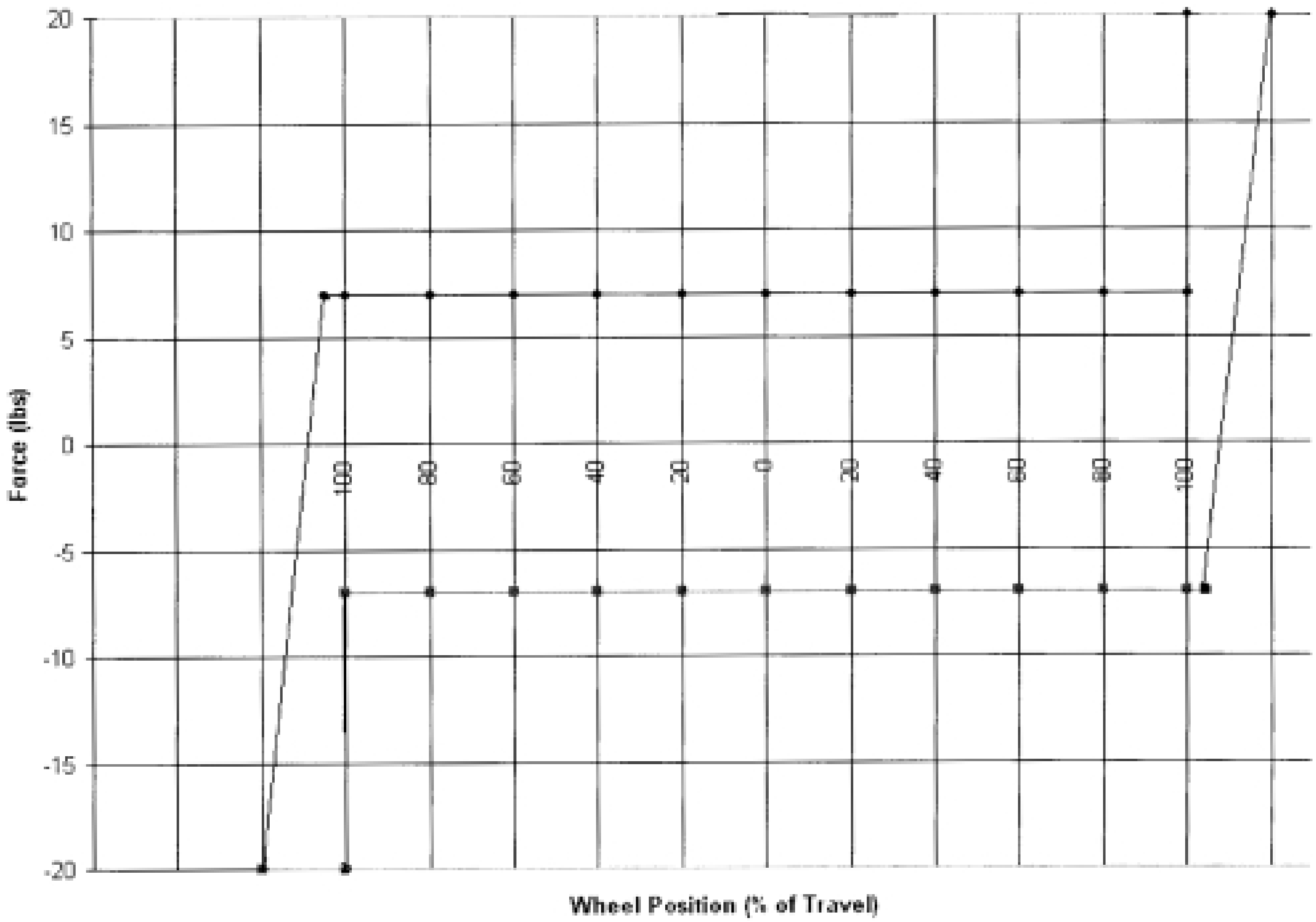
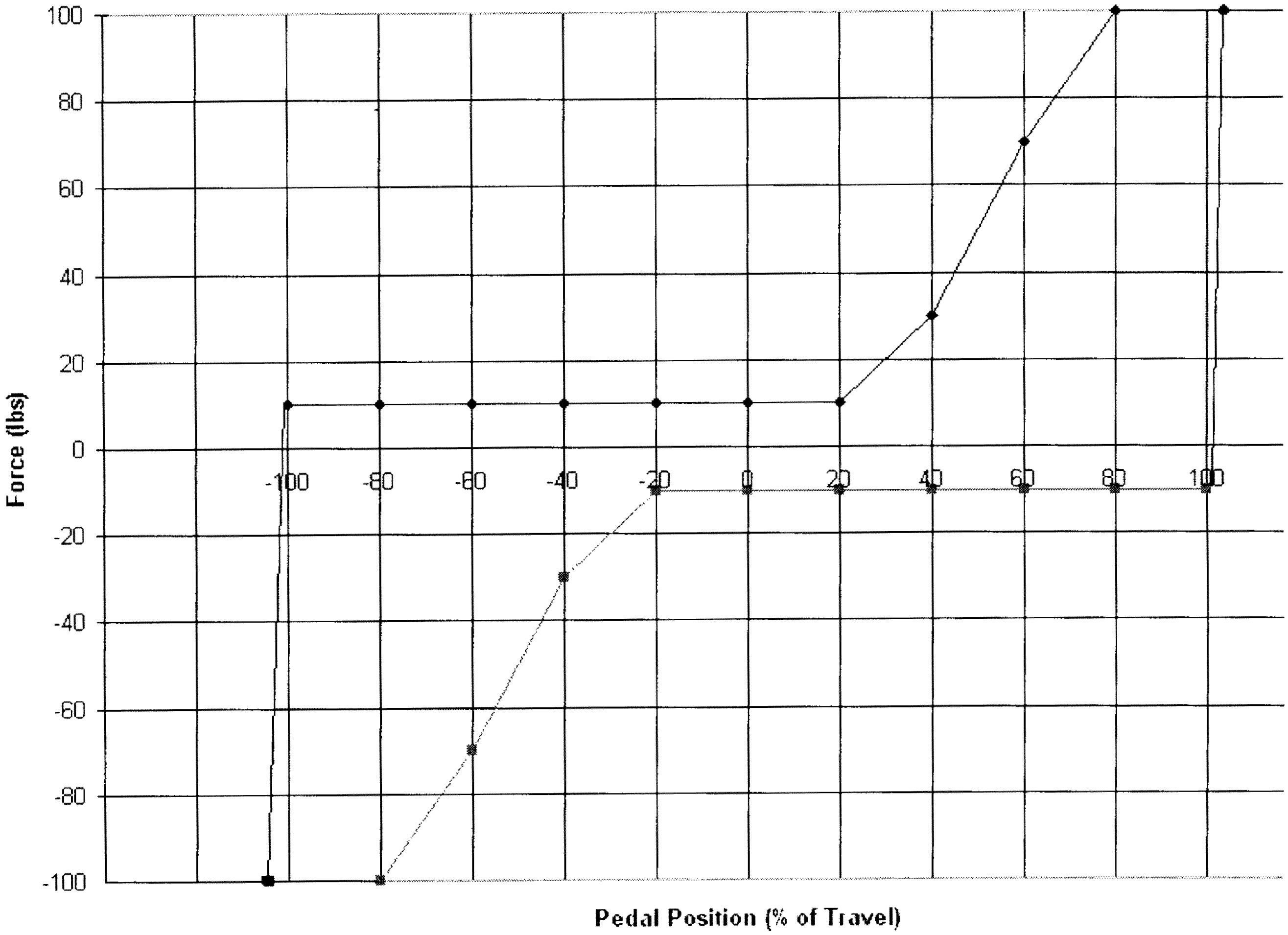


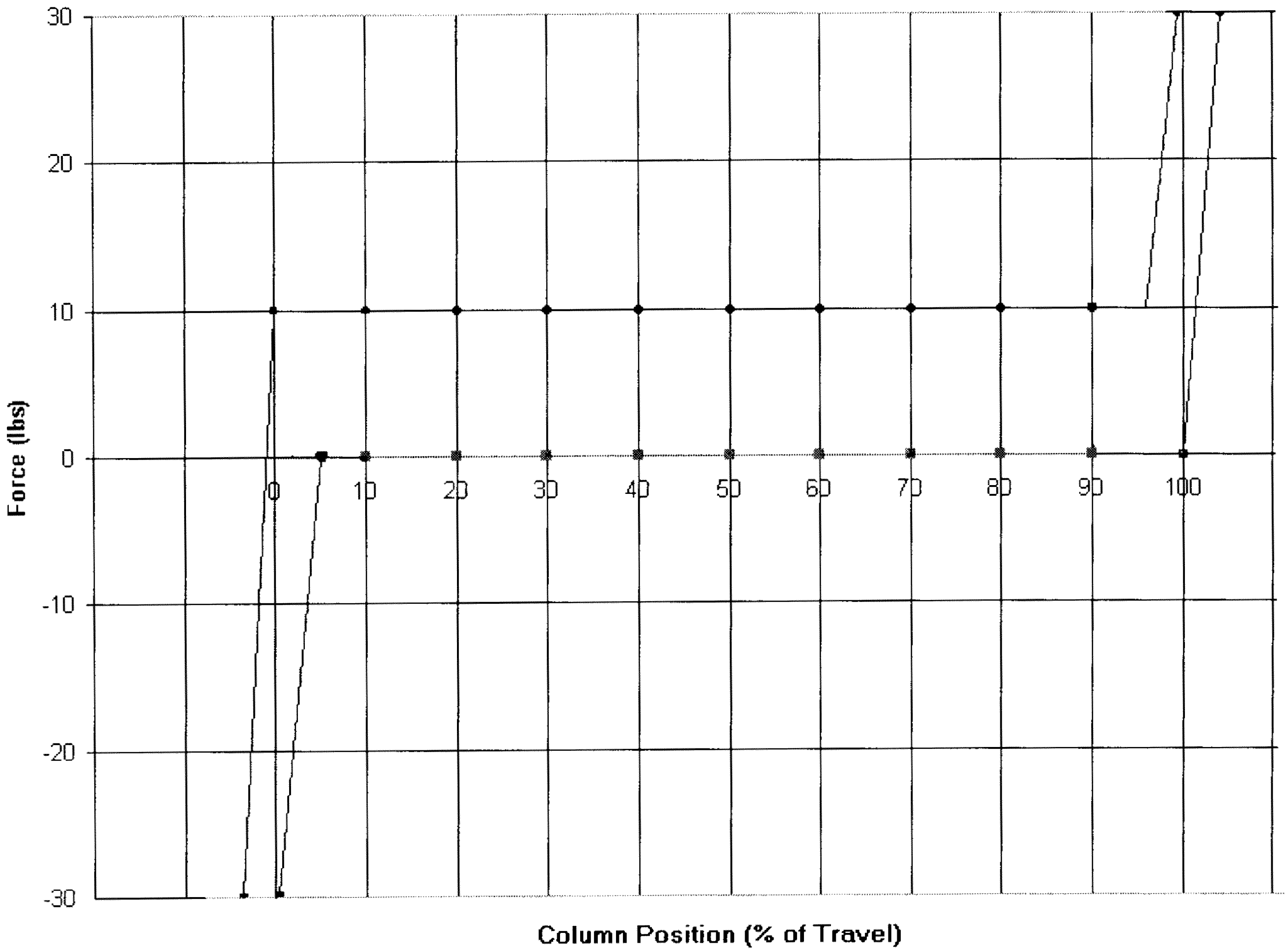
ATTACHMENT 2 TO APPENDIX B TO PART 60—
FIGURE 4. SMALL, MULTI-ENGINE (RECIPROCATION) AIRPLANE
COLUMN POSITION VS. FORCE



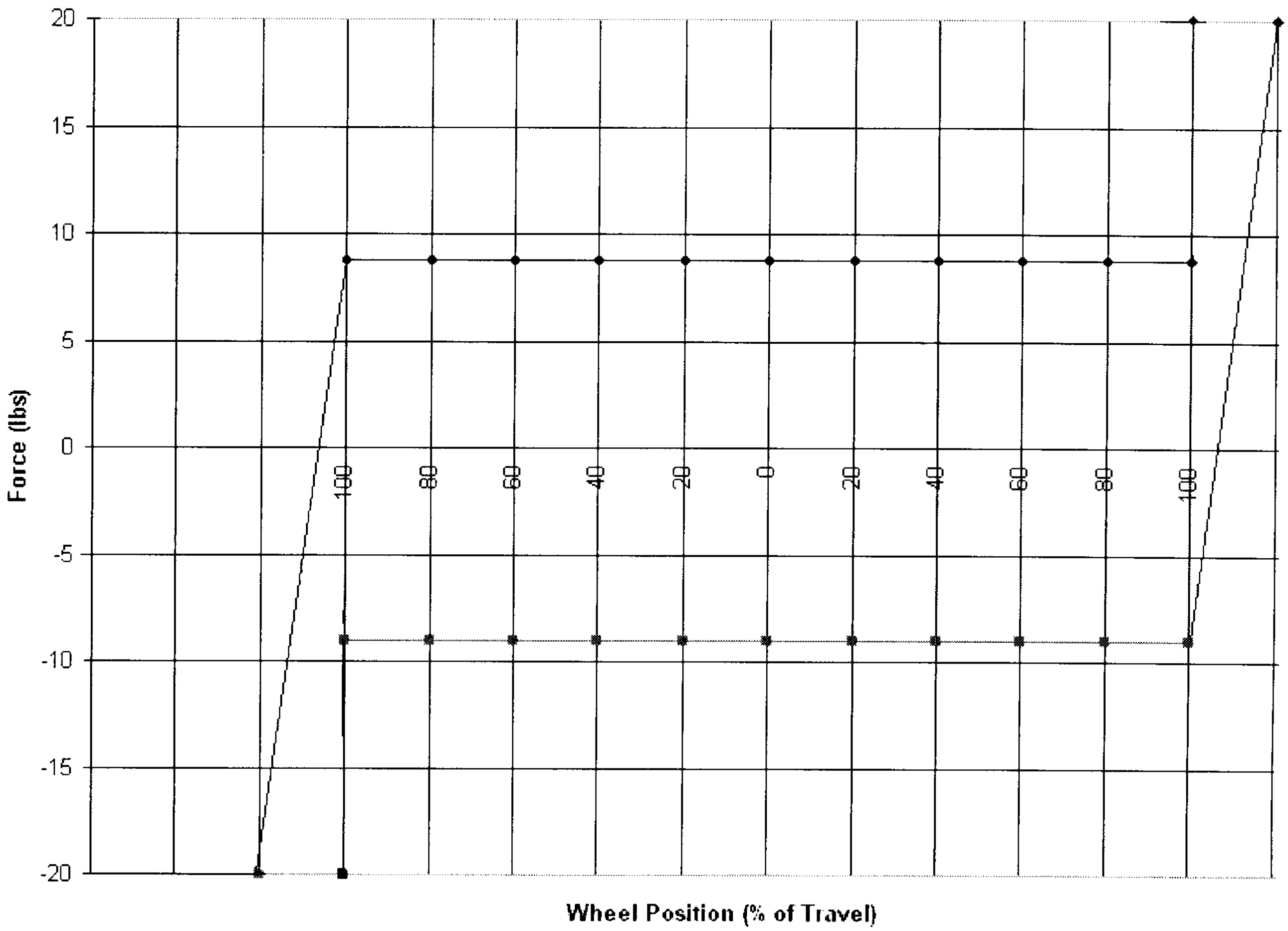
ATTACHMENT 2 TO APPENDIX B TO PART 60—
FIGURE 5. SMALL, MULTI-ENGINE (RECIPROCATING) AIRPLANE
WHEEL POSITION VS. FORCE



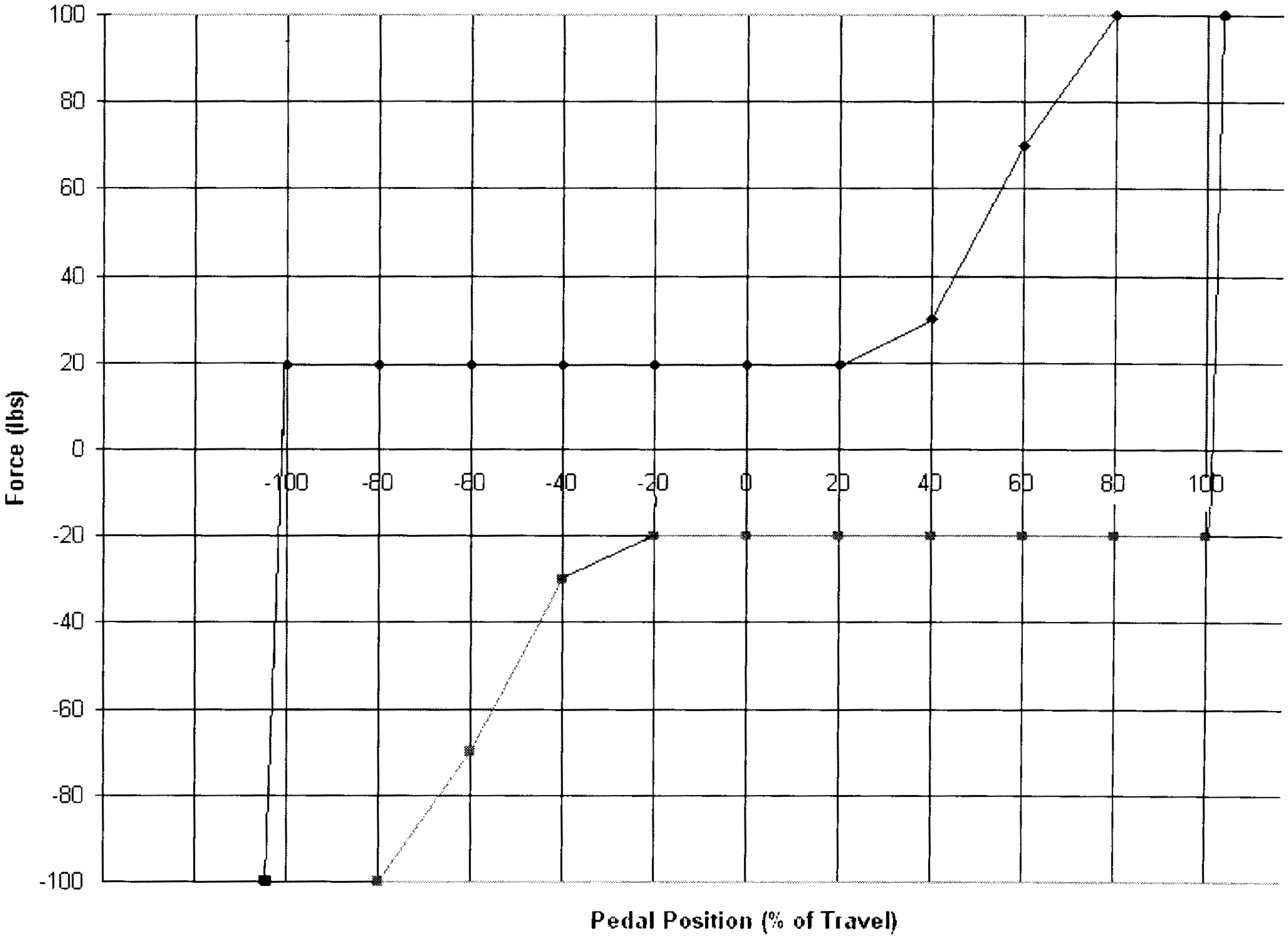
ATTACHMENT 2 TO APPENDIX B TO PART 60—
FIGURE 6. SMALL, MULTI-ENGINE (RECIPROCATING) AIRPLANE RUDDER PEDAL POSITION VS. FORCE



**ATTACHMENT 2 TO APPENDIX B TO PART 60—
FIGURE 7. SINGLE ENGINE TURBO-PROPELLER AIRPLANE
COLUMN POSITION VS. FORCE**



ATTACHMENT 2 TO APPENDIX B TO PART 60—
FIGURE 8. SINGLE ENGINE TURBO-PROPELLER AIRPLANE WHEEL POSITION VS. FORCE



**ATTACHMENT 2 TO APPENDIX B TO PART 60—
FIGURE 9. SINGLE ENGINE TURBO-PROPELLER AIRPLANE
RUDDER PEDAL POSITION VS. FORCE**

BILLING CODE 4910–13–C

TABLE OF ALTERNATIVE SOURCE DATA FTD LEVELS 2, 3, AND 5

[Multi Engine (Turbo-Propeller) Airplanes ≤ 19,000 Pounds]

QPS REQUIREMENT	
Applicable Test and Test Number	Authorized Performance Range
2. Performance	
a. Takeoff	
(1) Ground acceleration time; brake release to liftoff speed	20–30 Seconds.
b. Climb	
(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)
c. Ground Deceleration	
(1) Deceleration time from 90 knots to zero; with a nominal gross weight; using wheel brakes on a dry runway.	20–35 Seconds.
d. Engines	
(1) Acceleration; idle to takeoff power	2–6 Seconds.
(2) Deceleration; takeoff power to idle	1–5 Seconds.
3. Handling Qualities	
a. Static Control Checks	

TABLE OF ALTERNATIVE SOURCE DATA FTD LEVELS 2, 3, AND 5—Continued

[Multi Engine (Turbo-Propeller) Airplanes ≤ 19,000 Pounds]

QPS REQUIREMENT	
Applicable Test and Test Number	Authorized Performance Range
(1)(b) Column position vs. force	Plot of Column Position vs. Force must fall within the shaded areas shown in Figure 10, page 43 (Multi-Engine Turbo-Propeller Airplanes).
(2)(b) Wheel position vs. force	Plot of Wheel Position vs. Force must fall within the shaded areas shown in Figure 11, page 44 (Multi-Engine Turbo-Propeller Airplanes).
(3)(b) Pedal position vs. force	Plot of Rudder Pedal Position vs. Force must fall within the shaded areas shown in Figure 12, page 45 (Multi-Engine Turbo-Propeller Airplanes).
(4) Nosewheel steering force	Plot of Rudder Pedal Position vs. Force must fall within the shaded areas shown in Figure 12, page 45 (Multi-Engine Turbo-Propeller Airplanes).
(5) Rudder pedal steering calibration with full rudder pedal travel	10–30 degrees of nosewheel angle, both sides of neutral.
(8) Brake pedal position vs. force; at maximum pedal deflection	50–150 lbs (22–66 daN) of force.
b. Longitudinal	
(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.	(a) 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.	(b) 12–22 lbs (5.3–9.7 daN) of force (Push).
(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.	(a) 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 (fully retracted). After stabilized, record stick force necessary to maintain original airspeed.	(b) 5–15 lbs (2.2–6.6 daN) of force (Push).
(3) 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.	(a) 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.	(b) 2–12 lbs (0.88–5.3 daN) of force (Push).
(4) Gear and flap operating times	
(a) Extend gear	(a) 2–12 seconds.
(b) Retract gear	(b) 2–12 seconds.
(c) Extend flaps, zero to 50% travel	(c) 3–13 seconds.
(d) Retract flaps, 50% travel to zero	(d) 3–13 seconds.
(5) Longitudinal trim	Must be able to trim longitudinal stick force to ''zero'' in each of the following configurations: (a) cruise; (b) approach; and (c) landing.
(7) Longitudinal static stability	Must exhibit positive static stability.
Stall warning (actuation of stall warning device) with nominal gross weight; wings level; clean configuration, and a deceleration rate of approximately one (1) knot per second	
(a) Landing configuration	(a) 80–100 knots; ± 5 degrees of bank.
(b) Clean configuration	(b) Landing configuration speed + 10–20 percent.
(9)(b) Phugoid dynamics	(a) Must have a phugoid with a period of 30–60 seconds. (b) May not reach ½ or double amplitude in less than 2 cycles.
c. Lateral Directional	
(1) Roll response	

TABLE OF ALTERNATIVE SOURCE DATA FTD LEVELS 2, 3, AND 5—Continued

[Multi Engine (Turbo-Propeller) Airplanes ≤ 19,000 Pounds]

QPS REQUIREMENT	
Applicable Test and Test Number	Authorized Performance Range
(a) Roll rate must be measured through at least 30 degrees of roll. Aileron control must be deflected 50 percent of maximum travel.	Must have a roll rate of 6–40 degrees/second.
(2) Response to roll controller step input	
Trim for straight and level flight at nominal gross weight at approach airspeed. Roll into a 30 degree band turn and stabilize. When ready, input a 50 percent aileron control opposite the direction of turn. When reaching zero bank angle, rapidly neutralize the aileron control and release. Record the response from at least 2 seconds prior to initiation of control input at least 20 seconds after neutralization of the controls.	Roll rate must decrease to not more than 10 percent of the roll rate achieved, and must do so within 1–3 seconds.
(3)(a) and (b) Spiral stability	
Cruise configuration and normal cruise airspeed. Establish a 20–30 degree bank. When stabilized, neutralize the aileron control and release. (Must be completed in both directions of turn).	Initial bank angle (± 5 degrees) after 20 seconds.
(4)(b) Rudder response	
Use 50 percent of maximum rudder deflection	6–12 degrees/second yaw rate.
Applicable to approach or landing configuration.	
(5)(b) Dutch roll, yaw damper off	(a) A period of 2–5 seconds; and
Applicable to cruise and approach configurations.	(b) ½–3 cycles.
(6) Steady state sideslip	(a) 2–10 degrees of bank;
Use 50 percent rudder deflection	(b) 4–10 degrees of sideslip; and
Applicable to approach and landing configurations.	(c) 2–10 degrees of aileron.
4. Cockpit Instrument Response	
Instrument systems response to an abrupt pilot controller input. One test is required in each axis (pitch, roll, and yaw).	300 milliseconds or less.

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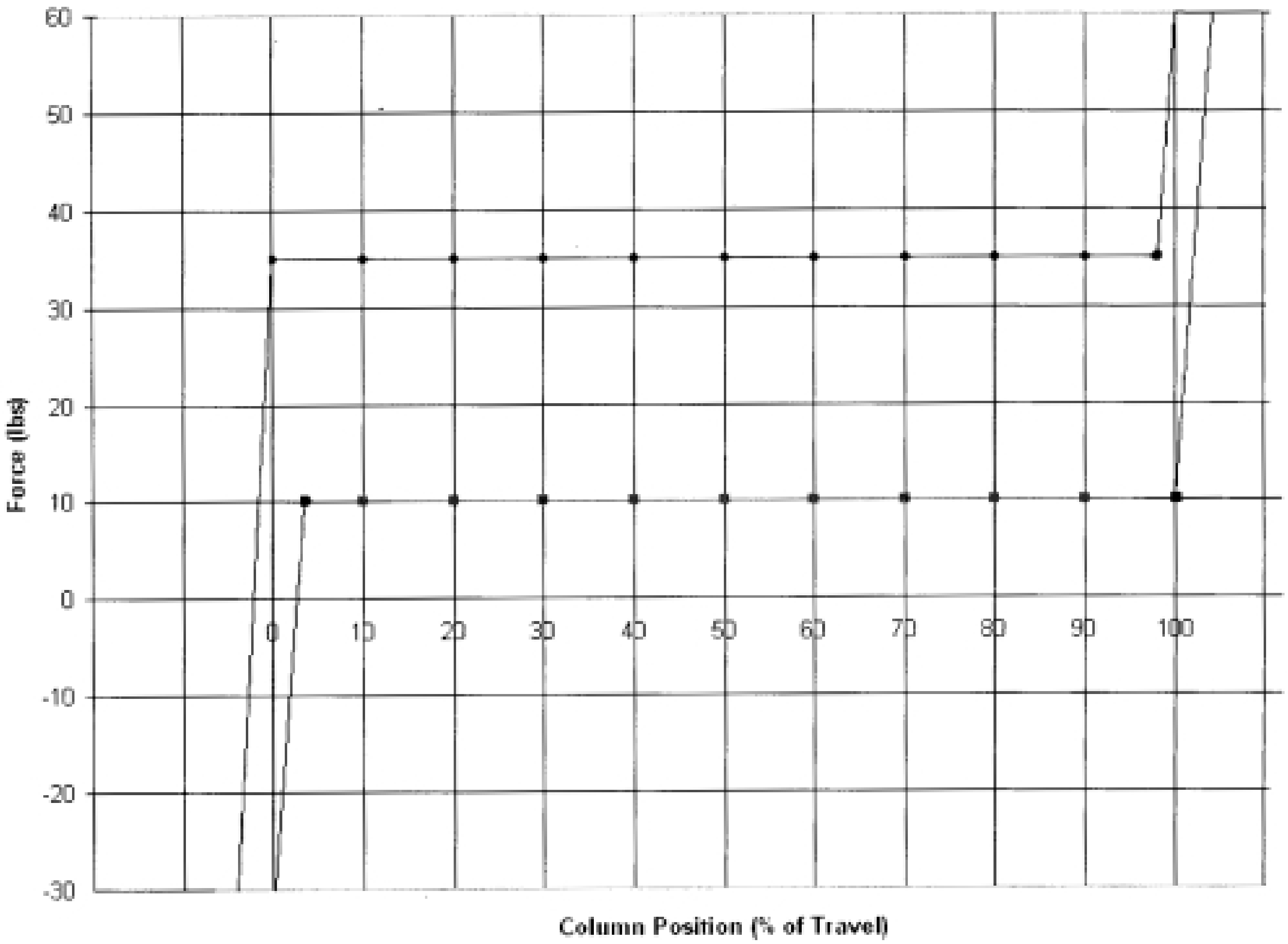
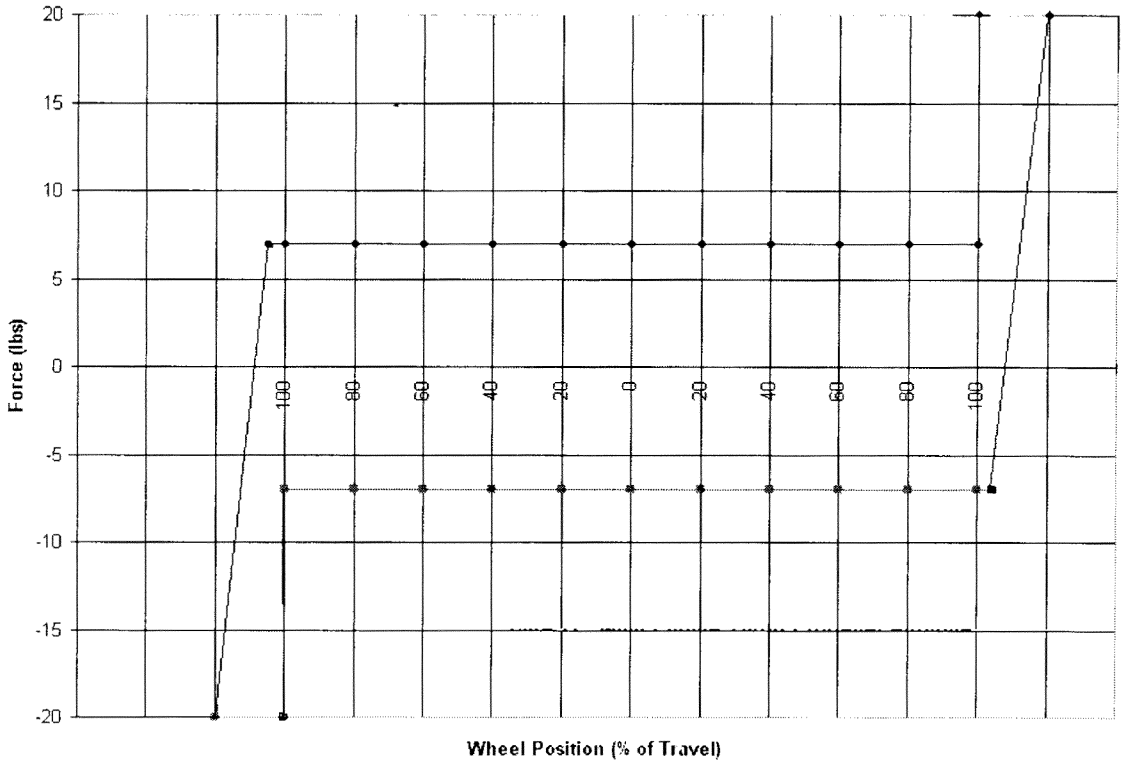
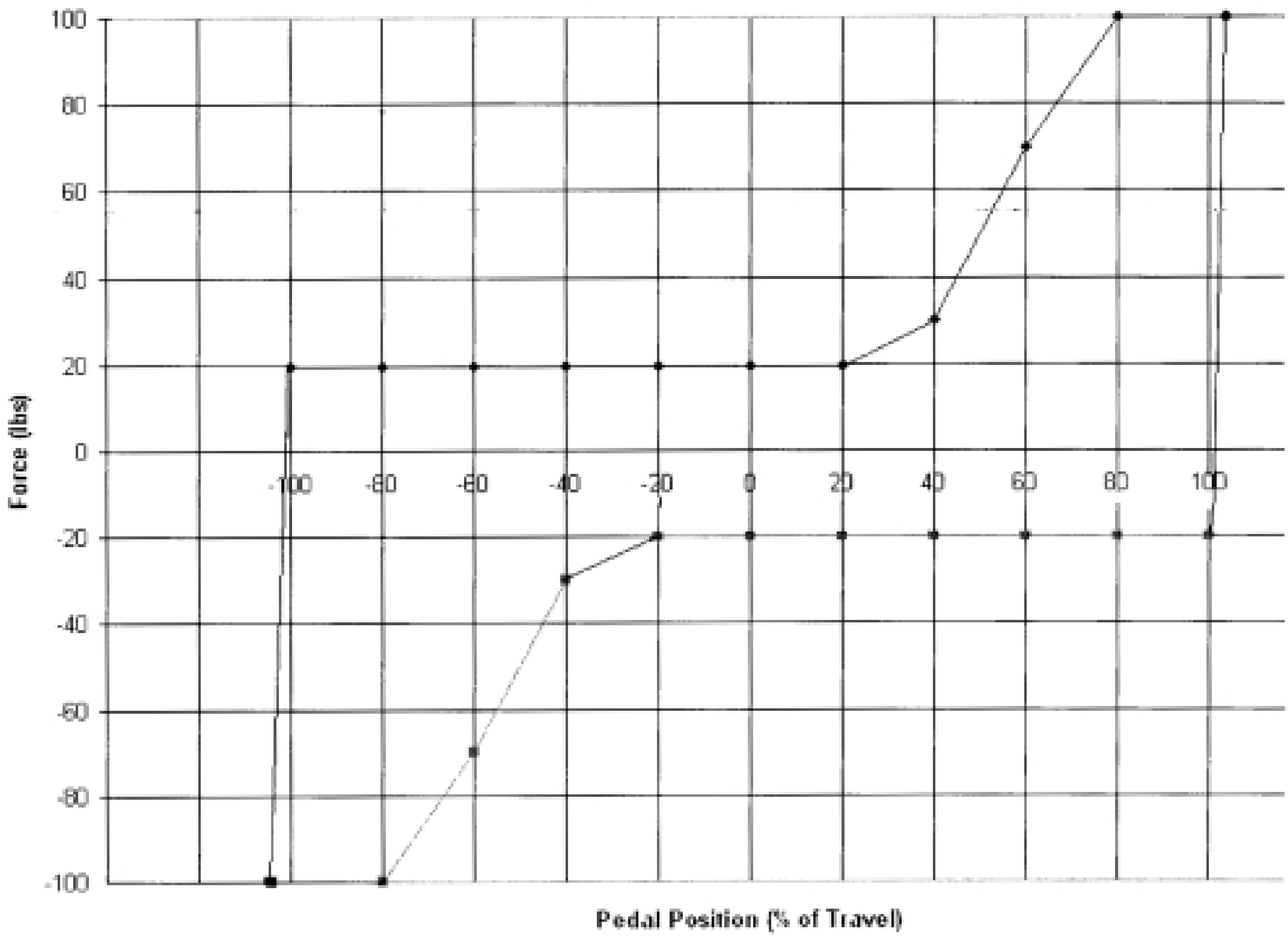


ATTACHMENT 2 TO APPENDIX B TO PART 60—
FIGURE 10. MULTI-ENGINE TURBO-PROPELLER AIRPLANE
COLUMN POSITION VS. FORCE



ATTACHMENT 2 TO APPENDIX B TO PART 60—
FIGURE 11. MULTI-ENGINE TURBO-PROPELLER AIRPLANE WHEEL POSITION VS. FORCE



ATTACHMENT 2 TO APPENDIX B TO PART 60—
FIGURE 12. MULTI-ENGINE TURBO-PROPELLER AIRPLANE
RUDDER PEDAL POSITION VS. FORCE

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6. Alternative Data Sources, Procedures, and Instrumentation: Level 6 FTD Only

Begin Information

a. In recent years, considerable progress has been made by highly experienced aircraft and FTD 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 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 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 FTD 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. Any of the FTD 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.

(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 6 FTDs (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 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 simulators.

End Information

TABLE OF ALTERNATIVE DATA SOURCES, PROCEDURES, AND INSTRUMENTATION: LEVEL 6 FTD ONLY

QPS requirement (if this source used)		
Applicable test and test No.	Alternative data sources, procedures, and instrumentation	Notes, reminders, and information
2.a.(1) Performance. Takeoff. Minimum Radius turn.	TIR, AFM, or Design data may be used.	
2.b.(1) Performance. Climb. Normal Climb	Data may be acquired with a synchronized video of: calibrated airplane instruments and engine power throughout the climb range.	
2.c.(1) Performance. In-Flight. 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. Handrecord the flight conditions and airplane configuration.	Airspeeds may be cross checked with those in the TIR and AFM.
2.d.(1) Performance. Ground. Deceleration Time, using manual application of wheel brakes and no reverse thrust.	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.d.(2) Performance. Ground. Deceleration Time, using reverse thrust and no wheel brakes.	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.(1) Performance. Engines. Acceleration	Data may be acquired with a synchronized video recording of: engine instruments and throttle position.	
2.e.(2) Performance. Engines. Deceleration	Data may be acquired with a synchronized video recording of: engine instruments and throttle position.	
3.a.(1)(b) Handing Qualities. Static Control Checks. Column Position vs. Force.	Force data may be acquired by using a hand held force gauge at selected, significant column positions (encompassing significant column position data points) acceptable to the NSPM.	
3.a.(2)(b) Handling Qualities. Static Control Checks. Wheel Position vs. Force.	Force data may be acquired by using a hand held force gauge at selected, significant wheel positions (encompassing significant wheel position data points) acceptable to the NSPM.	
3.a.(3)(b) Handling Qualities. Static Control Checks. Rudder Pedal Position vs. Force.	Force data may be acquired by using a hand held force gauge at selected, significant wheel positions (encompassing significant wheel position data points) acceptable to the NSPM.	

TABLE OF ALTERNATIVE DATA SOURCES, PROCEDURES, AND INSTRUMENTATION: LEVEL 6 FTD ONLY—Continued

QPS requirement (if this source used)		
Applicable test and test No.	Alternative data sources, procedures, and instrumentation	Notes, reminders, and information
3.a.(4) Handling Qualities. Static Control Checks. 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.	
3.a.(5) Handling Qualities. Static Control Checks. 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 nose wheel 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).	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.).	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.	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.b.(1) Handling Qualities. Longitudinal. 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 cockpit controls.	
3.b.(2) Handling Qualities. Longitudinal. Flap/Slat Change Force.	Data may be acquired by using an inertial measurement system and a synchronized video of: the calibrated airplane instruments; flap/slat position; and the force/position measurements of cockpit controls.	
3.b.(3) Handling Qualities. Longitudinal. 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 cockpit controls.	
3.b.(4) Handling Qualities. Longitudinal. Landing Gear and Flap/Slat Operating Times.	May use design data, production flight test schedule, or maintenance specification, together with an SOC.	
3.b.(5) Handling Qualities. Longitudinal. Longitudinal Trim.	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.b.(6) Handling Qualities. Longitudinal. 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.	

TABLE OF ALTERNATIVE DATA SOURCES, PROCEDURES, AND INSTRUMENTATION: LEVEL 6 FTD ONLY—Continued

QPS requirement (if this source used)		
Applicable test and test No.	Alternative data sources, procedures, and instrumentation	Notes, reminders, and information
3.b.(7) Handling Qualities. Longitudinal. 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.	
3.b.(8)(b) Handling Qualities. Longitudinal. 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 cockpit controls.	
3.c.(1) Handling Qualities. Lateral Directional. Roll Response (Rate)		
3.c.(2) Handling Qualities. Lateral Directional. (a) Roll Overshoot or (b) Roll Response to Cockpit 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 cockpit lateral controls.	
3.c.(4)(b) Handling Qualities. Lateral Directional. 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 cockpit controls; and a stop watch.	
3.c.(5)(a) Handling Qualities. Lateral Directional. 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.	
3.c.(6)(a) Handling Qualities. Lateral Directional. Dutch Roll, (Yaw Damper OFF).	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.c.(7) Handling Qualities. Lateral Directional. Steady State Sideslip.	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.	

Attachment 3 to Appendix B to Part 60—Flight Training Device (FTD) Subjective Tests

1. Discussion

Begin Information

a. The subjective tests provide a basis for evaluating the capability of the FTD to perform over a typical utilization period; determining that the FTD satisfactorily meets the appropriate training/testing/checking objectives and competently simulates each required maneuver, procedure, or task; and verifying correct operation of the FTD controls, instruments, and systems. The items in the list of operations tasks are for FTD evaluation purposes only. They must not be used to limit or exceed the authorizations for use of a given level of FTD 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 special effects and any installed visual system. 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 FTD Systems in paragraph 3 of this attachment addresses the overall function and control of the FTD including the various simulated environmental conditions; simulated airplane system operation (normal, abnormal, and emergency); and visual system displays and special effects (if either are applicable) that are used 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. 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 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

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2. List of Operations Tasks

Begin QPS Requirements

The NSP pilot, or the pilot designated by the NSPM, will evaluate the FTD in the following Operations Tasks, as applicable to the airplane and FTD 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 (or flight deck area) design and functions replicate the appropriate airplane or set of airplanes.

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 (as applicable, powerback requires visual system).
(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 (if applicable) requires visual system.
(g) Surface Movement and Guidance System (SMGS) (if applicable) requires visual system.
(h) Other.

c. Takeoff

(1) Normal.
(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) Instrument.
(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) Flight control system failure modes.
(d) Other.

d. Inflight Operation

(1) Climb.
(a) Normal.
(b) 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, over-speed 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.
(i) High angle of attack maneuvers in the following configurations: (i) cruise; (ii) takeoff or approach; and (iii) landing.
(j) Inflight engine shutdown (as applicable, procedures only).
(k) Inflight engine restart (as applicable, procedures only).
(l) Maneuvering with one or more engines inoperative (as applicable, procedures only).
(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 (if applicable, requires visual system).
(s) Operations during icing conditions.
(t) Traffic alert and collision avoidance.
(u) Effects of airframe icing.
(v) 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.
(e) 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).
(vii) Missed approach.
(b) Precision:
(i) Instrument Landing System (ILS)
A. Category I published:
i. Manually controlled with and without flight director to 100 feet below published decision height.
ii. With maximum demonstrated crosswind.
B. Category II published—with and without use of autopilot, autothrottle, and autoland, as applicable.
C. Category III published:
i. With minimum/standby electrical power.
ii. With generator/alternator failure (transient).
iii. With 10 knot tail wind.
iv. With 10 knot crosswind.
D. Missed approach.
(ii) Precision Approach Radar (PAR)
A. Normal.
B. With crosswind.
C. Missed approach.
(iii) Digital Global Positioning System (DGPS)
A. Normal.
B. With crosswind.
C. Missed approach.
(iv) Microwave landing system (MLS).
A. Normal.
B. With crosswind.
C. Missed approach.
(v) Steep Glide Path.
A. Normal.
B. With crosswind.
C. Missed approach.
(2) Visual Approach Maneuvers (if applicable, requires visual system).
(a) Abnormal wing flaps/slats.
(b) Without glide slope guidance or visual vertical flightpath aid (if applicable, requires visual system).
(3) Abnormal/emergency.
(a) With standby (or minimum) electric/hydraulic power.
(b) With longitudinal trim malfunction.
(c) With jammed or mis-trimmed horizontal stabilizer.
(d) With lateral-directional trim malfunction.
(e) With worst case failure of flight control system (most significant degradation of the computer controlled airplane which is not extremely improbable).
(f) Other flight control system failure modes as dictated by training program.
(g) Land and hold short operations.
(h) Other.

f. Missed Approach

(1) Manual.
(2) Automatic (if applicable).

g. Any Flight Phase

(1) Air conditioning.
(2) Anti-icing/deicing.
(3) Auxiliary powerplant.
(4) Communications.
(5) Electrical.
(6) Fire detection and suppression.
(7) Flaps.
(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.

h. Engine Shutdown and Parking

(1) Systems operation.
(2) Parking brake operation.

3. FTD 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) Selection.
 (b) Runway selection.
 (c) Preset positions (*e.g.* ramp, over FAF, etc.)
 (d) Other.
(4) Environmental controls.
 (a) Temperature.
 (b) Climate conditions (*e.g.*, ice, rain, *etc.*).
 (c) Wind speed and direction.
 (d) 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 (or other).
 (e) Other
(7) Remote IOS.
(8) Other.

b. Sound Controls. On / off / rheostat

c. Control Loading System. (as applicable) On / off / emergency stop.

d. Observer Stations.

(1) Position.
(2) Adjustments.

End QPS Requirements

Attachment 4 to Appendix B 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 out-of-the-cockpit view, a system that provides cues at least equivalent to those of a three-degree-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 chapter 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 FTD 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 FTD 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 FTD—is an FTD in which hardware and software can be changed so that the FTD becomes a replica of a different model, usually of the same type airplane. The same FTD 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 engine 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 FTD after completion of a control input or disturbance.

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

FTD Approval—is the extent to which an FTD may be used by a certificate holder as authorized by the FAA. It takes account of airplane to FTD differences and the training ability of the organization.

FTD Latency—is the additional time beyond that of the response time of the airplane due to the response of the FTD.

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

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.

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

Integrated Testing—is testing of the FTD 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 FTD 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 FTD manufacturer and the applicant to design, manufacture, and test the FTD.

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 FTD 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 FTD 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.

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 FTD will be used. This person is the principal operations inspector (POI) for programs approved under 14CFR parts 63, 121, 125, or 135; or the training center program manager (TCPM) for programs approved under part 141 or 142.

Transport Delay or ''Throughput''—is the total FTD 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 FTD performance corresponds to that of the airplane.

Validation Test—is a test by which FTD 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.
Kt—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—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.
Pf—Impact or Feel Pressure, often expressed as ''q.''.
PLA—Power Lever Angle.
PLF—Power for Level Flight.
psi—pounds per square inch.
QPS—Qualification Performance Standard.
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.
V_1—Decision speed
V_R—Rotation speed
V_2—Takeoff Safety Speed
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.
Vs—Stall Speed or minimum speed in the stall.
WAT—Weight, Altitude, Temperature.

End QPS Requirements

Attachment 5 to Appendix B to Part 60—Sample Documents

Begin Information

Table of Contents

Title of Sample

BILLING CODE 4910–13–P

Attachment 5 to Appendix B to Part 60—
Figure 1 – Sample Letter of Request

INFORMATION

Date

Name, TCPM, ______________________________(Certificate Holder)

FAA FSDO ______________________________

Address

City, State, Zip

Dear Mr./Ms. ____________________________:

(Sponsor's name) ____________________ requests evaluation of our __________________ (type airplane or set of airplanes) FTD for Level ______ qualification. The (name) ________________ FTD [with (name) ___________________visual system - if applicable] is fully defined on page ________ of the accompanying qualification test guide (QTG). We have completed tests of the FTD and confirm that it meets all applicable requirements of Title 14 of the Code of Federal Regulation (14 CFR) part 60 and the requirements of the Airplane Flight Training Device Qualification Performance Standards (QPS). Appropriate hardware and software configuration control procedures have been established.

Our pilot(s) (name) __________________ [and (name)__________________], who is(are) qualified on__________ (airplane type or set of airplanes) has(have) assessed the FTD and found that it conforms to the (sponsor name) ___________________ airplane (type or set of airplanes) cockpit configuration and that the simulated systems and subsystems have been evaluated and found to function equivalently to those in the airplane (or set of airplanes). The above named pilot(s) has(have) found that the FTD represents the respective airplane (or set of airplanes) in accordance with the attached Configuration List. He/She(They) has(have) also subjectively assessed the performance and flying qualities of the FTD and state that it represents the airplane (or set of airplanes). He/She(They) has(have) not subjectively tested the FTD for those tasks on the attached Restrictions-to-Qualification list and we do not seek qualification in these areas.

(Added comments as desired.)

Sincerely,

(Signature of Appropriate Person)

Attachment 5 to Appendix B to Part 60—

Figure 2 – Sample Qualification Test Guide Cover Page

INFORMATION

SPONSOR NAME

SPONSOR ADDRESS

FAA QUALIFICATION TEST GUIDE

(SPECIFIC AIRPLANE MODEL OR SET OF AIARPLANES)
for example
Stratos BA797-320A – or – Multi-Engine, Turbo-Propeller Driven

(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 5 to Appendix B to Part 60—
Figure 3 – Sample FTD Information Page

SPONSOR NAME	
SPONSOR FTD CODE:	BA-797 #1
AIRPLANE MODEL:	Stratos BA797-320A
AERODYNAMIC DATA REVISION:	BA797-320, CPX-8D, January 1988
ENGINE MODEL(S) AND REVISION:	CPX-8D; RPT-6, January 1988 DRQ-4002, RPT-3, April 1991
FLIGHT CONTROLS DATA REVISION:	BR707-320; May 1988
FLIGHT MANAGEMENT SYSTEM:	Berry XP
FTD MODEL AND MANUFACTURER:	MTD-797, Tinker Simulators, Inc.
DATE OF FTD MANUFACTURE:	1988
FTD COMPUTER:	CIA
VISUAL SYSTEM MODEL, MANUFACTURER, and DISPLAY TYPE:	ClearView, Inc. "The World" 1 Channel, 2-window CRT display
VISUAL SYSTEM COMPUTER:	LMB-1
MOTION SYSTEM:	N/A

Information on this page must be updated and kept current with any modifications or changes made to the FTD and reflected on the log of revisions and the list of effective pages.

Attachment 5 to Appendix B to Part 60—
Figure 4 – Sample Statement of Qualification

Federal Aviation Administration
National Simulator Program

Statement of Qualification

This is to certify that representatives of the
National Simulator Program
Completed an evaluation of the

Go-Fast Training Center
Stratos BA-797 Flight Training Device
FAA Identification Number 721

And found it to meet the standards set forth
In the Qualification Performance Standards
For a Flight Training Device at

Level 6

(date) for the NSPM

Subject to the attached
Configuration List and Restrictions

Attachment 5 to Appendix B to Part 60—
Figure 4A – Sample Statement of Qualification; Configuration List

INFORMATION

STATEMENT of QUALIFICATION
CONFIGURATION LIST
Go-Fast Training Center Stratos BA-797 -- Level 6 -- FAA ID# 721

Configuration		Date Qualified
Airplane Model:..........................	BA-797..	July 12, 1988
Engine Model(s) and Revision:...	☐ CPX-8D, RPT-6........................	July 12, 1988
	☐ DRQ-4002, RPT-3....................	April 1, 1991
Flight Management System:.......	Berry XP.......................................	July 12, 1988
Visual System / Manufacturer:	The World, Clear View, Inc.	
☐ CRT Installation:....................	1 Channel, 2 Window....................	July 12, 1988
☐ Projected System:....................	__° Horizontal Viewing Angle........	
Flight Instruments:		
☐ Electro-Mechanical:.................	....	July 12, 1988
☐ Display (CRT, LCD, etc.).......		
☐ Combination		
☐ Heads-Up Display..................	Jones Industries..............................	December 1, 1993
Flight Director:		
☐ Single Cue..............................		
☐ Dual Cue................................	Sperry..	July 12, 1988
☐ None.....................................		
Engine Instruments:		
☐ Electro-Mechanical.................	....	July 12, 1988
☐ Display (CRT, LCD, etc.).......		
☐ Combination...........................		
Navigation Type(s):		
☐ ADF.......................................	....	July 12, 1988
☐ VOR/ILS...............................	....	July 12, 1988
☐ GPS.......................................		
☐ INS..	....	October 10, 1991
☐ IRS.......................................		
Weather Radar:	Jones Industries, Inc.	August 3, 1996
TCAS		
ACARS		

(Continue, As Needed)

Attachment 5 to Appendix B to Part 60—
Figure 4B – Sample Statement of Qualification; Qualified/Non-Qualified Tasks

INFORMATION

STATEMENT of QUALIFICATION
Qualified/Non-Qualified Tasks
Go-Fast Training Center
Stratos BA-797 -- Level 6 -- FAA ID# 721

The following are those items listed in the Airplane Flight Training Device Qualification Performance Standards (QPS), FAA-S-120-45B, dated (May 1, 2000) Appendix 3, Subjective Tests, indicating what tasks and systems are qualified **(Q)** *and what tasks and systems are not qualified* **(NQ)**.

NQ	Q	TASK	NQ	Q	TASK
		A. Preparation for Flight.			**D. In-flight Operation.**
	X	Preflight.			1. Climb.
		B. Surface Ops (Pre-Takeoff).		X	(a) Normal.
		1. Engine start.		X	(b) Other.
	X	(a) Normal start.			2. Cruise.
	X	(b) Alternate start operations.		X	(a) Performance (speed vs. power).
	X	(c) Abnormal starts		X	(b) Turns w/wo spoilers
	X	2. Pushback		X	(c) High altitude handling.
X		3. Powerback.		X	(d) High airspeed handling
		4. Taxi	X		(e) Mach effects
	X	(a) Thrust response.		X	(f) Normal and steep turns.
	X	(b) Power lever friction.	X		(g) Performance turns.
	X	(c) Ground handling.			(h) Approach to stalls
	X	(d) Nosewheel scuffing.		X	1) cruise
	X	(e) Brake operation		X	2) takeoff or approach
	X	(f) Other.		X	3) landing
		C. Takeoff.			(i) High AOA maneuvers
		1. Normal.	X		1) cruise
	X	(a) Propulsion system checks	X		2) takeoff or approach
	X	(b) Airplane acceleration	X		3) landing
	X	(c) Nosewheel/rudder steering		X	(j) In-flight engine shutdown
	X	(d) Crosswind (max. demo)		X	(k) In-flight engine restart
X		(e) Special performance.		X	(l) Maneuver w/ engine(s) inop.
	X	(f) Landing gear, flap/slat ops.	X		(m) Slow flight.
	X	(g) Other.	X		(n) Spec flight characteristics.
		2. Abnormal/Emergency.	X		(o) Manual flight control
	X	(a) Rejected, with brake fade	X		(p) Other flight control failures
X		(b) Rejected, special perf.		X	(q) Holding.
X		(c) Flight control system failure.		X	(r) Ops. in icing conditions
	X	(d) Other.	X		(s) TCAS

Initials _______ Date _________ (Continued)

NQ	Q	TASK	NQ	Q	TASK
	X	(t) Effects of airframe icing.	X		B. With crosswind.
	X	(u) Other.	X		C. Missed approach.
		3. Descent.			(vi) MLS.
	X	(a) Normal.	X		A. Normal
	X	(b) Max. rate and recovery	X		B. With crosswind.
X		(c) Flight control failure	X		C. Missed approach.
	X	(d) High sink rate and recovery.			(vii) Steep Glide Path.
	X	(e) Other.	X		A. Normal
		E. Approaches.	X		B. With crosswind.
		1. Instrument Approach	X		C. Missed approach.
		(a) Non-precision:			2. Visual Approach Maneuvers.
	X	(i) NDB		X	(a) Abnormal wing flaps/slats
	X	(ii) VOR,		X	(b) No G/S or visual flightpath aid.
X		(iii)RNAV,			3. Abnormal/emergency.
X		(iv)TACAN		X	(a) One engine inoperative.
	X	(v) DME Arc		X	(b) Min. electric/hydraulic power.
	X	(vi) LOC/FC.		X	(c) Pitch trim malfunction.
	X	(vii) LOC/BC,		X	(d) Jammed horizontal stabilizer.
X		(viii) LDA,		X	(e) Roll/Yaw trim malfunction.
X		(ix) SDF	X		(f) Worst Flt Cont fail. (+**CCA**).
X		(x) ASR.	X		(g) Other failures / trng. prog.
X		(xi) GPS.		X	(h) Other.
	X	(xii) Missed approach.			**F. Missed approach.**
		(b) Precision:		X	1. Manual.
		(i) ILS Category I	X		2. Automatic (if applicable).
	X	A. Manual w/wo flight director			**J. Any Flight Phase.**
	X	B. Max. crosswind		X	1. Air conditioning.
		(ii) ILS Category II		X	2. Anti-icing/deicing.
	X	A. W/Wo Auto-Couple		X	3. Auxiliary powerplant.
	X	B. Max. crosswind		X	4. Communications.
		(iii) ILS Category III		X	5. Electrical.
X		A. Min./stnby. electrical power.		X	6. Fire detection and suppression.
X		B. Generator/alternator failure		X	7. Flaps/Slats.
X		C. Tail wind 10 knots		X	8. Flight cont (+ spoiler/spdbrake).
X		D. Crosswind 10 knots		X	9. Fuel and oil.
		(iv) PAR		X	10. Hydraulic.
X		A. Normal		X	11. Landing gear.
X		B. With crosswind.		X	12. Oxygen.
X		C. Missed approach.		X	13. Pneumatic.
		(v) DGPS		X	14. Propulsion System.
X		A. Normal		X	15. Pressurization.

Initials _______ Date _________ (Continued)

NQ	Q	TASK	NQ	Q	TASK
	X	16. Flt mgmt / guidance systems.		X	25. Navigation systems.
	X	17. Auto landing aids.		X	26. Weather radar.
	X	18. Auto-pilot.		X	27. Stall warning/avoidance.
	X	19. Auto-throttle.	X		28. Stability augmentation.
	X	20. Flight data displays.	X		29. ACARS.
	X	21. Flight mgmt computers.		X	30. Other.
	X	22. Flight Director.			**K. Eng. Shutdown and Parking.**
	X	23. Flight Instruments.		X	1. Systems operation.
	X	24. HUD system.		X	2. Parking brake operation.

Initials _______ Date__________

(Continued)

NQ	Q	FTD SYSTEM		NQ	Q	FTD SYSTEM
		A. Inst. Ops. Station (IOS).				**B. Sound Controls.**
	X	1. Power switch(es).			X	-- On / off / rheostat
		2. Airplane conditions.				**C. Control Loading System.**
	X	(a) GW, CG, Fuel weight, etc.			X	On / off /.
	X	(b) Airplane systems status.				**D. Observer Stations.**
	X	(c) Ground crew functions			X	1. Position.
	X	(d) Other.			X	2. Adjustment.
		3. Airports.				
	X	(a) Number and selection.				
	X	(b) Runway selection.				
	X	(c) Preset positions				
	X	(d) Lighting controls.				
	X	(e) Other.				
		4. Environmental controls.				
	X	(a) Temperature.				
	X	(b) Climate conditions				
	X	(c) Wind speed and direction.				
	X	(d) Other.				
		5. Airplane system malfunctions.				
	X	(a) Insertion / deletion.				
	X	(b) Problem clear.				
	X	(c) Other				
		6. Locks, freezes, repositioning.				
	X	(a) Problem freeze / release.				
	X	(b) Position freeze / release.				
	X	(c) Repositioning				
	X	(d) Ground speed control				
	X	(e) Other				
X		7. Remote IOS.				
	X	8. Other.				

Initials _______ Date__________ -- End --

Attachment 5 to Appendix B to Part 60—
Figure 5 – Sample Recurrent Evaluation Requirements Page

INFORMATION

Recurrent Evaluation Requirements ***Completed at conclusion of Initial Evaluation***	
Recurrent Evaluations to be conducted each _(fill in)__ months Allotting ______ hours of FTD time. Signed: ______________________________ NSPM / Evaluation Team Leader	Recurrent evaluations are due as follows: _(month)__ and __(month)_ and __(month)_ (enter or strike out, as appropriate) ____________________ Date

Revision: Based on (enter reasoning):	
Recurrent Evaluations are to be conducted each _(fill in)__ months. Allotting ______ hours. Signed: ______________________________ NSPM Evaluation Team Leader	Recurrent evaluations are due as follows: _(month)__ and __(month)_ and __(month)_ (enter or strike out, as appropriate) ____________________ Date

Revision: Based on (enter reasoning):	
Recurrent Evaluations are to be conducted each _(fill in)__ months. Allotting ______ hours. Signed: ______________________________ NSPM Evaluation Team Leader	Recurrent evaluations are due as follows: _(month)__ and __(month)_ and __(month)_ (enter or strike out, as appropriate) ____________________ Date

(Repeat as Necessary)

Attachment 5 to Appendix B to Part 60—
Figure 6 – Sample Request for Initial, Upgrade, or Reinstatement Evaluation Date

INFORMATION

Mr. Edward Cook
Manager, National Simulator Program
Federal Aviation Administration
P.O. Box 20636 (AFS-205)
Atlanta, GA 30320

Dear Mr. Cook:

RE: Request for Initial [Upgrade / Reinstatement] Evaluation Date

This is to advise you of our intent to request an evaluation of our (Aircraft type or set / Level) FTD located in (City/State) at the (Facility) on (proposed evaluation date). [The proposed evaluation date must not be more than 180 days following the date of this letter.] This FTD [has / has not] been previously qualified by the FAA [and had been issued FAA identification number XXX]. [The history of this FTD is as follows: ______________________________.]

We agree to provide a Qualification Test Guide (QTG) to your staff not later than 45 days prior to the proposed evaluation date (if tests not run at training site, an additional "1/3 on-site" tests must be provided not later than 14 days prior the proposed evaluation date). If we are unable to meet the above date for the evaluation, this may result in a significant delay, perhaps 45 days or more, in rescheduling and completing the evaluation.

[Added comments from Operator/Sponsor, if any]

Please contact (Name and Telephone 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 our Principal Operations Inspector (POI) and/or Training Center Program Manager (TCPM).

Sincerely,

(Signature)

Acknowledgement:

____ We concur with your proposed dates.

____ The date requested is not available, however, we propose the following date:

____ Please provide us with the following information:

______________________________ ____________
Scheduler, National Simulator Program Date

Attachment 5 to Appendix B to Part 60—
Figure 7 – Sample MQTG Index of Effective FSD Directives.

INFORMATION

Index of Effective FSD Directives
Filed in this Section

Notification Number	Received From: (TPAA/NSPM)	Date of Notification	Date of Modification Completion

Continue as Necessary....

BILLING CODE 4910–13–C

Attachment 6 to Appendix B to Part 60—Record of FSD Directives

Begin QPS Requirements

When the FAA determines that modification of an FTD is necessary for safety reasons, all affected FTDs must be modified accordingly, regardless of the original qualification standards applicable to any specific FTD.

a. A copy of the notification to the sponsor from the TPAA or NSPM that a modification is necessary will be filed in and maintained as part of this attachment.

b. The effective FSD Directives, including the date of the directive, the direction to make these changes, and the date of completion of any resulting modification must be maintained in a separate section of the MQTG and index accordingly. The MQTG must also be updated to include the information described in § 60.15(b)(4) as may be appropriate as a result of the FSD Directive. See Attachment 5, Figure 7, of this appendix for a sample Index of Effective FSD Directives.

End QPS Requirements

Appendix C to Part 60—Qualification Performance Standards for Helicopter Flight Simulators

Begin Information

This appendix establishes the standards for Helicopter Flight Simulator evaluation and qualification. The Flight Standards Service, National Simulator Program (NSP) staff, under the direction of the NSP Manager (NSPM), is responsible for the development, application, and interpretation of the standards contained within this appendix.

The procedures and criteria specified in this document will be used by the NSPM, or a person or persons assigned by the NSPM (*e.g.*, FAA pilots and/or FAA aeronautical engineers, assigned to and trained under the direction of the NSP—referred to as NSP pilots or NSP engineers, other FAA personnel, etc.) when conducting helicopter flight simulator evaluations.

Table of Contents

1. Introduction

a. This appendix contains background information as well as information that is either directive or guiding in nature. Information considered directive is described in this document in terms such as ''will,'' ''shall,'' and ''must,'' and means that the actions are mandatory. Guidance information is described in terms such as ''should,'' or ''may,'' and indicate actions that are desirable, permissive, or not mandatory and provide for flexibility.

b. To assist the reader in determining what areas are directive or required and what areas are guiding or permissive—

(1) The text in this appendix is contained within sections, separated by horizontal lines; headings associated with these horizontal lines will indicated that a particular section begins or ends. All of the text falls into one of three sections: a direct quote or a paraphrasing of the Part 60 rule language; additional requirements that are also regulatory but are found only in this appendix; and advisory or informative material.

(2) The text presented between horizontal lines beginning with the heading ''Begin Rule Language'' and ending with the heading ''End Rule Language,'' is a direct quote or is paraphrased from Part 60 of the regulations. For example: the rule uses the terms ''flight simulation device (FSD)'' and ''aircraft;'' however, in this appendix the rule is paraphrased and the term ''simulator'' is used instead of FSD, and ''airplane'' is used instead of aircraft. Additionally, the rule uses the terms ''this part'' and ''appropriate QPS;'' however, in this appendix the rule is paraphrased and the terms ''Part 60'' and ''this appendix,'' respectively, are used instead. (Definitions are not paraphrased or modified in any way.) For ease of referral, the Part 60 reference is noted at the beginning and the end of the bordered area.

(3) The text presented between horizontal lines beginning with the heading ''Begin QPS Requirements'' and ending with the heading ''End QPS Requirements,'' is also regulatory but is found only in this appendix.

(4) The text presented between horizontal lines beginning with the heading ''Begin Information'' and ending with the heading ''End Information,'' is advisory or informative.

(5) The tables in this appendix have rows across the top of each table—

(a) The data presented in columns under the heading ''QPS REQUIREMENTS'' is regulatory but is found only in this appendix.

(b) The data presented in columns under the heading ''INFORMATION'' is advisory or informative.

Important Note: While this appendix contains quotes and paraphrasing directly from the rule, the reader is cautioned not to rely solely on this appendix for regulatory requirements regarding flight simulators. For regulatory references for airplane flight simulators, the reader is referred to paragraphs 3.a through h of this appendix.

c. Questions regarding the contents of this publication should be sent to: U.S. Department of Transportation, Federal Aviation Administration, Flight Standards Service, National Simulator Program Staff, AFS–205, PO Box 20636 Atlanta, Georgia 30320. Telephone contact numbers are: phone, 404–305–6100; fax, 404–305–6118. The National Simulator Program Internet Web Site address is: *www.faa.gov/nsp.* On this Web Site you will find an NSP personnel list with contact information, a list of qualified flight simulation devices, advisory circulars, 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.

d. The NSPM encourages the use of electronic media for communication and the gathering, storage, presentation, or transmission of any record, report, request, test, or statement required by this QPS provided the media used has adequate provision for security and is acceptable to the NSPM. The NSPM recommends inquiries on system compatibility prior to any such activity. Minimum System requirements may be found on the NSP Web site.

End Information

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2. Definitions

Begin Information

See Attachment 4 of this appendix for a list of definitions and abbreviations. Attachment 4 of this appendix contains definitions directly quoted from 14 CFR Part 1 or Part 60, contained within a bordered area with Red-colored left hand columns, indicating they are quoted from 14 CFR Part 1 or Part 60 and are regulatory. Additional definitions and abbreviations used in reading and understanding this document are contained within bordered areas with Blue-colored left hand columns, indicating they are also regulatory but appear only within this document. For purposes of accuracy, the definitions listed are directly quoted, and are not paraphrased.

End Information

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3. Related Reading References

Begin Information

a. 14 CFR part 60.
b. 14 CFR part 61.
c. 14 CFR part 63.
d. 14 CFR part 121.
e. 14 CFR part 125.
f. 14 CFR part 135.
g. 14 CFR part 141.
h. 14 CFR part 142.
i. Advisory Circular (AC) 120–28C, Criteria for Approval of Category III Landing Weather Minima.
j. AC 120–29, Criteria for Approving Category I and Category II Landing Minima for part 121 operators.
k. AC 120–35B, Line Operational Simulations: Line-Oriented Flight Training, Special Purpose Operational Training, Line Operational Evaluation.
l. AC 120–41, Criteria for Operational Approval of Airborne Wind Shear Alerting and Flight Guidance Systems.
m. AC 120–57A, Surface Movement Guidance and Control System (SMGS).
n. AC 150/5300–13, Airport Design.
o. AC 150/5340–1G, Standards for Airport Markings.
p. AC 150/5340–4C, Installation Details for Runway Centerline Touchdown Zone Lighting Systems.
q. AC 150/5340–19, Taxiway Centerline Lighting System.
r. AC 150/5340–24, Runway and Taxiway Edge Lighting System.
s. AC 150/5345–28D, Precision Approach Path Indicator (PAPI) Systems.
t. International Air Transport Association document, ''Flight Simulator Design and Performance Data Requirements,'' Fifth Edition (1996).
u. AC 29–2B, Flight Test Guide for Certification of Transport Category Rotorcraft.
v. AC 27–1A, Flight Test Guide for Certification of Normal Category Rotorcraft.
x. International Civil Aviation Organization (ICAO) Manual of Criteria for the Qualification of Flight Simulators, First Edition, 1994 Doc 9625–AN/938.
y. Airplane Flight Simulator Evaluation Handbook, Volume I (February, 1995) and Volume II (July, 1996), The Royal Aeronautical Society, London, UK.
z. FAA Publication FAA–S–8081 series (Practical Test Standards for Airline Transport Pilot Certificate, Type Ratings, Commercial Pilot, and Instrument Ratings).

End Information

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4. Background

Begin Information

a. The FAA has been involved in flight simulator evaluation and approval for well over three decades. As far back as 1954, air carriers were allowed to perform limited proficiency check maneuvers in airplane simulators. Credit for the use of these devices was hampered by the state of the technology available in early simulator development. More recently, however, rapid technological advances have permitted and encouraged the expanded use of flight simulators in the training and checking of flightcrew members. In addition, the complexity, operating costs, and operating environment of modern aircraft have lead to the increasing use of advancing simulator technology. Extensive experience has proven that modern simulators can provide more in-depth training than can be accomplished in the aircraft as well as provide a very high transfer of learning and behavior from the simulator to the aircraft. Additionally, their use, in lieu of aircraft, results in safer flight training and cost reductions for the operators, while achieving fuel conservation and a significant reduction in environmental impact.

b. In recognition of expanding flight simulator capabilities, as technology has progressed, regulatory revisions have been developed to permit the increased use of airplane simulators in approved training programs. However, the helicopter simulators in use today, in large part, have been evaluated and approved on a case-by-case basis. Previously, those persons using helicopter simulators had received credit for training or checking only through exemption to the regulations. While this situation is changing, the regulations regarding the use of helicopter simulators have not kept pace with their airplane counterparts—and has resulted in rather limited use of helicopter simulators to meet regulatory required training, testing, or checking activities.

c. The same factors that have led to the widespread use and acceptance of airplane simulators, such as technological advancements, aircraft complexity, operating cost, operating environment, enhanced training, safety, environmental impact, etc. have recently spurred a dramatic increase in interest in helicopter simulators. The FAA anticipates that the use of helicopter simulators will expand rapidly and that applicable regulations will be amended to extend formal credit to the use of these simulators in FAA-approved flight training programs.

d. For information purposes, the following is a chronological listing of the documents preceding this document that have addressed the qualification criteria for helicopter simulator evaluation and qualification by the FAA, including the effective dates of those documents:

AC 120–63—10/11/94 to (date TBD)

End Information

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5. Quality Assurance Program

Begin Rule Language (§ 60.5)

a. After [date 6 months after the effective date of the final rule], no sponsor may use or allow the use of or offer the use of a simulator for flightcrew member training or evaluation or for obtaining flight experience to meet any requirement of this chapter unless the sponsor has established and follows a quality assurance (QA) program, acceptable to the NSPM, for the continuing surveillance and analysis of the sponsor's performance and effectiveness in providing a satisfactory simulator for use on a regular basis as described in the appropriate QPS.

b. The QA program must provide a process for identifying deficiencies in the program and for documenting how the program will be changed to address these deficiencies.

c. Whenever the NSPM finds that the QA program does not adequately address the procedures necessary to meet the requirements of this part, the sponsor must, after notification by the NSPM, change the program so the procedures meet the requirements of this part.

d. Each sponsor of a simulator must identify to the NSPM and to the TPAA, by name, one individual, who is an employee of the sponsor, to be the management representative (MR) and the primary contact point for all matters between the sponsor and the FAA regarding the qualification of that simulator as provided for in this part.

End Rule Language (§ 60.5)

Begin QPS Requirements

e. The Director of Operations for a Part 119 certificate holder, the Chief Instructor for a Part 141 certificate holder, or the equivalent for a Part 142 or Flight Engineer School sponsor, must designate a management representative who has the responsibility and authority to establish and modify the sponsor's policies, practices, and procedures regarding the QA program for the recurring qualification of, and the day-to-day use of, each simulator.

f. An acceptable Quality Assurance (QA) Program must contain a complete, accurate, and clearly defined written description of and/or procedures for—

(1) The method used by management to communicate the importance of meeting the regulatory standards contained in Part 60 and this QPS and the importance of establishing and meeting the requirements of a QA Program as defined in this paragraph f.

(2) The method(s) used by management to determine that the regulatory standards and the QA program requirements are being met, and if or when not met, what actions are taken to correct the deficiency and prevent its recurrence.

(3) The method used by management to determine that the sponsor is, on a timely and regular basis, presenting a qualified simulator.

(4) The criteria for and a definition or description of the workmanship expected for normal upkeep, repair, parts replacement, modification, *etc.,* on the simulator and how, when, and by whom such workmanship is determined to be satisfactorily accomplished.

(5) The method used to maintain and control appropriate technical and reference documents, appropriate training records, and other documents for—

(a) continuing simulator qualification; and

(b) the QA program.

(6) The criteria the sponsor uses (*e.g.*, training, experience, *etc.*) to determine who may be assigned to duties of inspection, testing, and maintenance (preventive and corrective) on simulators.

(7) The method used to track inspection, testing, and maintenance (preventive and corrective) on each simulator.

(8) The method used by the sponsor to inform the TPAA in advance of each scheduled NSPM-conducted evaluation and after the completion, the results of each such evaluation.

(9) The method used to ensure that instructors, check airmen, and those who conduct the daily preflight, are capable of determining what circumstance(s) constitute(s) a discrepancy regarding the simulator and its operation.

(10) The method used to ensure that instructors, check airmen, and those who conduct the daily preflight, record in the simulator discrepancy log each simulator discrepancy and each missing, malfunctioning, or inoperative simulator component.

(11) The method used to ensure that instructors and check airmen are completely and accurately logging the number of disruptions and time not available for training, testing, checking, or for obtaining flight experience during a scheduled simulator use-period, including the cause(s) of the disruption.

(12) The method used by the sponsor to notify users of the simulator of missing, malfunctioning, or inoperative components that restrict the use of the simulator.

(13) The method of recording NSPM-conducted evaluations and other inspections (*e.g.*, daily preflight inspections, NASIP inspections, sponsor conducted quarterly inspections, *etc.*), including the evaluation or inspection date, test results, discrepancies and recommendations, and all corrective actions taken.

(14) The method for ensuring that the simulator is configured the way the helicopter it represents is configured and that if the configuration is authorized to be changed that the newly configured system(s) function(s) correctly.

(15) The method(s) for:

(a) determining whether or not proposed modifications of the helicopter will affect the performance, handling, or other functions or characteristics of the helicopter; and

(b) determining whether or not proposed modifications of the simulator will affect the performance, handling, or other functions or characteristics of the simulator;

(c) coordinating and communicating items 5.f.(15)(a) and (b) of this appendix, as appropriate, with the sponsor's training organization, other users (*e.g.*, lease or service contract users), the TPAA, and the NSPM.

(16) How information found in the discrepancy log is used to correct discrepancies and how this information is used to review and, if necessary, modify existing procedures for simulator maintenance.

(17) The method for how and when software or hardware modifications are accomplished and tracked, documenting all changes made from the initial submission.

(18) The method used for determining that the simulator meets appropriate standards each day that it is used.

(19) The method for acquiring independent feedback regarding simulator operation (from persons recently completing training, evaluation, or obtaining flight experience; instructors and check airmen using the simulator for training, evaluation or flight experience sessions; and simulator technicians and maintenance personnel) including a description of the process for addressing these comments.

(20) How devices used to test, measure, and monitor correct simulator operation are calibrated and adjusted for accuracy, including traceability of that accuracy to a recognized standard, and how these devices are maintained in good operating condition.

(21) How, by whom, and how frequently internal audits of the QA program are