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**Federal Aviation
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NSP GB

National Simulator Program
FSTD Qualification Guidance Bulletin

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National Simulator Program Guidance Bulletin

An NSP GB contains valuable information for FSTD sponsors that should help them meet certain administrative, regulatory, or operational requirements with relatively low urgency or impact on safety.

Subject: FSTD Evaluation and Qualification for Full Stall Training Tasks

Purpose: To provide sponsors of level C and D FSTDs guidance on the evaluation and qualification for stall training maneuvers beyond the first indication of a stall as necessary to accomplish training objectives.

Background: On August 1, 2010, H.R. 5900 was passed into law becoming The Airline Safety and Federal Aviation Administration Extension Act of 2010, Public Law #111-216. Section 208(b.) of this act required the FAA to convene a multidisciplinary panel to study methods for improving crewmember familiarity and responsiveness to stick pusher systems, icing conditions, microburst and wind shear weather events. It also directed the FAA to conduct rulemaking proceedings that require part 121 air carriers to provide flight crewmembers with ground, flight, or flight simulator training to recognize and avoid a stall, or, if not avoided, to recover from the stall. On November 12, 2013, the FAA published the Crewmember and Aircraft Dispatcher Training final rule¹, requiring several significant new training tasks. These tasks included extended envelope training, recovery from bounced landings, enhanced runway safety training, and enhanced training on crosswind takeoffs and landings with gusts. The final rule also required that these maneuvers be completed in an FSTD. Revisions to part 121 training programs are required by March 12, 2019.²

Through participation in several industry working groups³ and in consideration of the formal recommendations received from the SPAW ARC, the FAA determined that many existing FSTDs

¹ (Crewmember and Aircraft Dispatcher Training final rule), RIN 2120-AJ00. See 78 FR 67800 (Nov. 12, 2013).

² 14 CFR Part 121.423

³ Working groups included the International Committee on Aviation Training in Extended Envelopes (ICATEE), the Industry Stall and Stick Pusher Working Group, the Stick Pusher and Adverse Weather Event Training Aviation Rulemaking Committee (SPAW ARC), and the Loss of Control Avoidance and Recovery Training (LOCART) Working Group.

available for use by air carriers may not sufficiently represent the simulated aircraft for the required training tasks. On March 30, 2016, revisions to 14 CFR Part 60 were published to ensure that FSTDs are properly evaluated in order to fully implement the flight training required in the Crewmember and Aircraft Dispatcher Training final rule. After March 12, 2019, any FSTD used for full stall recovery training maneuvers must be evaluated and issued additional qualification to conduct these tasks in an FAA approved flight training program.

Revision	Description of Change	Effective Date
0	Original Draft.	1/22/2014
1	Updated for Publication of 14 CFR Part 60 Change 2	04/11/2016
2	Updated Compliance Dates and Qualification Process section.	02/21/2018
3	Updated to include clarification on the objective and subjective testing required for FSTDs not qualified for full stall training tasks.	04/27/2018

General Information

Earlier FSTD requirements for stall maneuvers were generally limited to the evaluation of stall speeds with little emphasis on actual performance and handling characteristics as the aircraft exceeded the stall warning angle of attack. Consequently, FSTDs did not always provide the necessary cues and associated performance degradation needed to train the recognition of an impending stall or techniques needed to recover from a stalled flight condition. On March 30, 2016, the FAA published changes to the 14 CFR Part 60 Qualification Performance Standards (QPS) including updated general, subjective, and objective testing requirements⁴ for high angle of attack modeling and the qualification of full stall maneuvers on Level C and Level D FSTDs. This final rule became effective on May 31, 2016

These changes are applicable to any Level C or Level D FSTD to be used for training of full stall tasks. Retroactive requirements for previously qualified FSTDs differ slightly and are provided in FSTD Directive 2. These requirements offer some relief from objective testing where previous validation data may be inadequate to meet the new testing requirements however; existing FSTDs used to conduct full stall training tasks must meet the new general requirements for high angle of attack modeling.

For either new or previously qualified FSTDs, a subjective evaluation of stall characteristics by a Subject Matter Expert (SME) is required that meets the criteria in Part 60, Appendix A, Attachment 7.

FSTD qualification for full stall training tasks is not mandatory. Sponsors may elect not to qualify a new or previously qualified FSTD for full stall training tasks. FSTDs not qualified for full stall training tasks, however, will be limited to approach-to-stall training with the limitation clearly indicated on the Statement of Qualification (see the technical requirements section in this document for alternate testing required for approach-to-stall qualification). After March 12, 2019, any FSTD used to conduct full stall maneuvers must be evaluated and issued qualification to conduct these tasks in an FAA approved flight-training program.

Compliance Dates and Qualification Process

Initial FSTD Qualifications: Level C and Level D FSTDs that are initially qualified after the effective date of the final rule and used to obtain credit for full stall training maneuvers must meet the new QPS requirements at the time of initial qualification. The Part 121 compliance date for full stall training is March 12, 2019.

Previously Qualified FSTDs: After March 12, 2019, any FSTD used to conduct full stall training tasks must meet the requirements as defined in FSTD Directive 2. Directive 2 is located in Attachment 6 of the QPS Appendix. Where qualification is requested, each FSTD sponsor is

⁴ These requirements correspond to Part 60 Appendix A, Attachments 1, 2, & 3.

required to perform FSTD modifications under § 60.23 as applicable, conduct testing as described in the Directive, and apply for additional FSTD qualification under § 60.16. Where a modification will require a full QTG submission or multiple modifications are installed concurrently, the sponsor must notify the NSP. Unanticipated NSP review could delay qualification.

Where sponsors intend to update a significant number of FSTDs for full stall training or other Directive 2 training tasks, they are encouraged to engage the NSP and share their update schedule in advance of official modification notification. Doing so will facilitate the scheduling process

The qualification process is as follows:

1. Utilizing NSP Form T011-FD2,⁵ submit notification of intent to qualify the FSTD for full stall maneuvers and describe any modifications to the FSTD. Per §60.23, the NSP and TPAA must be notified. Where scheduling of large FSTD fleets create special considerations for notification, sponsors should contact the NSP.
2. The notification should be accompanied by the required Statements of Compliance, objective QTG cases, and other materials indicated on the T011-FD2 form. The TPAA may or may not wish to receive the validation materials. Sponsors should consult their TPAA to this end. If supporting documents are not available at the time of notification, submission must be made at a time that is mutually agreeable to both the sponsor and the NSP.
3. Once the FSTD modifications and sponsor evaluation are completed, submit the confirmation statement that the modified FSTD has been subjectively evaluated by a qualified SME pilot as described in §60.16(a)(1)(iii) using NSP Form T012.

The NSPM will review each submission, determine if requirements have been met, and respond to the FSTD Sponsor as described in § 60.23(c). This response, along with any noted restrictions, may serve as an Interim Qualification until a permanent change is made to the Statement of Qualification (SOQ) following the next scheduled NSP conducted FSTD evaluation. Alternatively, the NSP may elect to conduct an update evaluation before the modified FSTD may be used in training.

During onsite evaluations, the NSP team may actively exercise the device or observe the execution of the maneuver by the SME. The team will also evaluate the IOS presentation for suitability and appropriate function. The SME (and instructor if present) should be familiar with these functions and effective use of the utilities. The evaluation team may ask for a demonstration of the training profile and an explanation of how the IOS utility is used by the instructor to evaluate the maneuver.

The IOS utility is indispensable in the training of full stall maneuvers. . In practice, a stall maneuver may only last seconds making IOS page navigation impractical. The presentation should have the

⁵ This form is intended for the notification of intent to use an FSTD for full stall and stick pusher maneuvers, upset recognition and recovery maneuvers, maneuvers conducted in icing conditions, takeoff and landing maneuvers in gusting crosswinds, and bounced landing recovery maneuvers in accordance with FSTD Directive 2.

capability to display multiple parameters simultaneously and must possess clear indications of parameter exceedance. It is essential that the size and presentation of the display (or portable tablet) facilitate interpretation of all parameters. NSP Guidance Bulletin 11-05 describes the IOS utilities in more detail and provides a pictorial of a typical presentation.

Technical Requirements

All level C and D FSTDs initially qualified after the effective date of the final rule and used to obtain credit for full stall training maneuvers in an FAA approved training program, must meet the requirements for full stall qualification and be evaluated in accordance with 14 CFR Part 60 effective May 31, 2016. Table 1 below lists the specific technical requirement references.

Table 1 - Full Stall Qualification Standards (Part 60 Change 2)

Pt 60 Table / Reference	Title	Section / Test	Name / Description
A1A	General Requirements (including SOC for high aerodynamic stall model & SME evaluation)	2.m	High Angle of Attack Modeling
A1A	General Requirements (including SOC)	3.f	Stick Pusher System
A2A	Objective Testing Requirements	2.a.10	Stick Pusher Force Calibration
A2A	Objective Testing Requirements	2.c.8.a	Stall Characteristics
A2A	Objective Testing Requirements	3.f.5	Characteristic Motion Vibrations – Stall Buffet
A3A	Functions and Subjective Testing Requirements	5.b.1.b	High Angle of Attack Maneuvers
Attachment 7	Additional Simulator Qualification Requirements	Appendix A	High Angle of Attack Model Evaluation

Note: Where the sponsor elects not to qualify an FSTD for full stall training tasks as described in Table A1B section 3.b.2, this testing will not be required for initial qualification of the FSTD. In lieu of the objective and subjective testing standards for the evaluation of full stall characteristics, testing of the approach-to-stall characteristics of the FSTD must be provided as described in Table A2A, test 2.c.8.b (approach-to-stall characteristics) and Table A3A, test 5.b.1.a (high angle of attack maneuvers).

Previously qualified level C and D FSTDs used for full stall training maneuvers must be evaluated and qualified in accordance with Section I of FSTD Directive 2. FSTD Directive 2 offers relief from objective testing where validation data may be inadequate to meet new testing requirements. Differences in the requirements for previously qualified devices are summarized in Table 2 below. Sponsors should reference the complete Directive found in Attachment 6 of part 60, Appendix A.

Table 2 - Full Stall Qualification Standards, Differences for Previously Qualified Devices in accordance with FSTD Directive 2

Part 60 Requirement Reference	Difference for Previously Qualified Devices
Table A1A, 2.m High AOA Modeling	None.
Table A1A, 3.f Stick Pusher Modeling	None.
Table A2A, Test 2.a.10 Stick Pusher Force Test	None.
Attachment 6, (FSTD Directive 2) Section I, Paragraph 4(b) & 4(c)	<p>a. Objective testing for stall characteristics (Table A2A, test 2.c.8.a) is required only for (wings level) 2nd segment climb and approach or landing flight conditions*. In lieu of objective testing for high altitude cruise and turning flight stall conditions, these maneuvers may be subjectively evaluated by a qualified subject matter expert (SME) pilot and addressed in the required statement of compliance.</p> <p>b. If existing flight test validation data in the FSTD Master Qualification Test Guide (MQTG) is missing required parameters or is otherwise unsuitable to fully meet objective testing requirements, the FAA may accept alternate sources of validation including subjective validation by a SME pilot with direct experience in stall characteristics of the aircraft.</p>
Attachment 6, (FSTD Directive 2) Section I, Paragraph 4(c)	<p>c. Objective testing for Characteristic Motion Vibrations - Stall Buffet (Table A2A, 3.f.5), is not required if the FSTD stall buffets have been subjectively evaluated by an SME pilot. For previously qualified Level D FSTDs that have objective stall buffet tests in their approved MQTG, these test results must be provided to the FAA with the updated stall model and buffet in place.</p>
Table A3A, Test 5.b.1.b Functions & Subjective Tests	None.
Attachment 6, (FSTD Directive 2) Section I, Paragraph 4(d)	<p>d. [SME evaluation on an engineering or development simulator] Where the SME evaluation takes place on an engineering or development simulator, additional objective “proof of match” testing for all flight conditions as described in tests 2.c.8.a. and 3.f.5.will be required to verify the implementation of the stall model and stall buffets on the training FSTD.</p>
Attachment 7 Additional Simulator Qualification Requirements	None.

* Although (wings level) 2nd segment climb and approach or landing flight conditions were required in 14 CFR Part 60 effective 2008, sponsors should note that the tolerances for these tests have been updated in Part 60 effective 2016.

Sponsors must review the complete technical requirements for FSTD qualification of full stall maneuvers as published in applicable sections of the rule. A brief summary of the requirements follows:

High Angle of Attack Aerodynamic Model: Aerodynamic stall modeling is discussed in Appendix A, Table A1A (2m) and Attachment 7 of the final rule. The aerodynamic model must exhibit airplane type specific recognition cues of the first indication of the stall, an impending stall, and recognition cues / handling qualities from the stall break through recovery. As appropriate for the aircraft type, stall modeling must include degradation in static/dynamic lateral-directional stability, degradation in control response (pitch, roll, and yaw), uncommanded roll response or roll-off requiring moderate to extreme control deflection to counter, apparent randomness or non-repeatability, changes in pitch stability, Mach effects, and stall buffet. The aerodynamic model must incorporate an angle of attack and sideslip range to support the training tasks. At a minimum, the model must support an angle of attack range to ten degrees beyond the stall identification angle of attack⁶ as defined in Attachment 7, Section I, paragraph 4b.

Aerodynamic Model Statement of Compliance (SOC): The SOC must describe the aerodynamic modeling methods, validation, and identify the sources of data used to develop the aerodynamic model. The FSTD sponsor must declare the range of angle of attack and sideslip where the aerodynamic model remains valid for training. This range should be presented by means of an alpha/beta envelope plot for a minimum of flaps up and flaps down aircraft configurations. Appendix A, Attachment 7, paragraph 4a. requires a list of maneuver types per flap setting used to define the aerodynamic model for angle of attack ranges greater than the first indication of stall. The aerodynamic model must incorporate and the SOC must state the specific stall characteristics applicable to the aircraft type that a pilot or evaluator will experience in the FSTD (see Attachment 7, paragraph 4c). Where appropriate, the effects of computer controlled airplane envelope protection or stick pusher system should be discussed. Finally, where known limitations exist in the aerodynamic model for particular stall maneuvers (i.e. lack of data for a particular aircraft configurations or stall entry method, etc.), these limitations must be declared.

Subject Matter Expert and Evaluation: During the qualification of an FSTD for full stall maneuvers, an evaluation by a qualified Subject Matter Expert (SME) pilot with direct experience in the stall characteristics of the aircraft being simulated or one sharing the same type rating as the make, model, and series of the simulated aircraft is required. The SME must evaluate the FSTD for the presence of appropriate cues and handling characteristics for approach to stall, stall, and stall recovery with stick pusher activation (where applicable) including initial pilot resistance to such activation. Evaluation must include the flight conditions and stall entry methods presented in Appendix A, Table A2A, (2.c.8.a). This evaluation will be required only once unless the stall model is modified from what was originally evaluated and qualified by the FAA. Suggested content of a subjective evaluation for full stall maneuvers in qualifying an FSTD may be found in Attachment 1 of this NSP Guidance Bulletin. In order to qualify as an acceptable

⁶ Also applies to airplanes equipped with stall envelope protection systems where protection must be disabled or otherwise degraded.

Subject Matter Expert, the pilot must meet specific requirements. These requirements are completely outlined in Appendix A, Attachment 7, Section A, paragraph 5.

SME Statement of Compliance: The SOC should confirm the subjective evaluation of the FSTD by the SME pilot possessing direct knowledge of the aircraft's stall characteristics. The evaluation should confirm the presence of appropriate aircraft specific cues and handling characteristics during the required stall maneuvers and recoveries. The statement should also confirm correct reaction of auto-flight (autopilot, auto-throttle, etc.) and stall protection systems to ensure these systems react correctly to an impending stall or fully stalled flight condition.

Alternatively, where an FSTD shares common aerodynamic and flight control models with that of an engineering or development simulator acceptable to the FAA, the FAA will accept a Statement of Compliance from the data provider that confirms that the stall characteristics have been subjectively assessed by an SME pilot on the engineering simulator. In this case, additional objective "proof of match" testing for all flight conditions as described in tests 2.c.8.a. and 3.f.5. will be required to verify the implementation of the stall model and stall buffets on the training FSTD. Additional checkout documentation should be supplied to enable the subjective evaluation of stall characteristics that may not be common to the shared aerodynamic model (such as subjective tuning of the FSTD's stall buffets).

Where a SME pilot with the required qualifications is unavailable for a specific aircraft type, an FSTD sponsor may submit a request to the Administrator for approval of a deviation from the SME pilot experience requirements in paragraph 5 of Attachment 7. This request for deviation must include:

- An assessment of pilot availability that demonstrates that a suitably qualified pilot meeting the experience requirements of this section cannot be practically located.
- Alternative methods to subjectively evaluate the FSTD's capability to provide the stall recognition cues and handling characteristics needed to accomplish the training objectives.

Stick Pusher Systems: For aircraft equipped with a stick pusher system, control forces, displacement, and surface position must correspond to that of the airplane being simulated. An objective test to validate the transient forces as a result of stick pusher activation is required (see Table A2A, (2.a.10)). Additionally, a Statement of Compliance is required which verifies that the stick pusher system has been modeled, programmed, and validated using the aircraft manufacturer's design data or other acceptable data source as applicable for the aircraft type being simulated. The SOC must address, at a minimum, stick pusher activation and cancellation logic as well as system dynamics, control displacement and forces as a result of the stick pusher activation.

Instructor Operating Station Requirements: FSTDs qualified for full stall training tasks must also meet the instructor operating station (IOS) requirements for upset prevention and recovery training (UPRT) tasks as described in Table A1A, (2.n). Attachment 7, Section B provides additional details.

Objective OTG Tests: Table A2A outlines the new or updated objective testing requirements. Note that for FSTDs not qualified for full stall training tasks, the objective tests listed below are not required for initial qualification. In lieu of the stall characteristics objective tests (2.c.8.a) required for full stall qualification, the approach-to-stall characteristics tests (2.c.8.b) must be provided.

- **2.a.10** - Stick Pusher System Force Calibration is a new test to objectively measure column force during system activation. The test is required for all new or previously qualified FSTDs used for full stall training.
- **2.c.8.a** - Stall Characteristics. In addition to the previous 3 kt. stall speed tolerance, new tolerances and trends are required including buffet threshold of perception. For FSTDs initially qualified after the effective date of the final rule, a high altitude cruise condition is required in addition to the second segment climb and approach/ landing cases. Stall entry methods for wings level (1g), accelerated (turning flight at least 25-degree bank angle), and power-on (propeller aircraft only) conditions must be demonstrated in at least one of the three required flight conditions.

For previously qualified FSTDs, only second segment climb and approach or landing cases wings level (1g) full stall cases are required; however, the updated tolerances and trends still apply. In lieu of the high altitude and turning stall objective test cases, an acceptable SME evaluation of these conditions addressed in the Statement of Compliance will be accepted. Where required data is unavailable, the FAA may accept alternates sources of data (see Part 60 Attachment 6, FSTD Directive 2).

**Note: In full stall qualifications accomplished to date, the NSP has observed that random directional and lateral roll-off has been disabled for objective auto-test repeatability. This practice is acceptable, but for the purposes of initial and continuing FSTD qualification, the NSP will require the enabling of random characteristics for objective testing conducted manually.*

- **3.f.5** - Stall Buffet. Objective buffet testing is now required for high altitude, second segment climb and approach or landing flight conditions. See table A2A, (3.f.5) for specific details. Objective testing is not required for previously qualified FSTDs where stall buffets have been subjectively evaluated by a SME pilot. Level D FSTDs that already have a stall buffet test, however, must preserve this test in the MQTG and evaluate it with the updated stall model and buffet in place.

Additional Reading:

1. AC 120-111 – FAA Advisory Circular for Upset Prevention and Recovery Training.
2. AC 120-109A – FAA Advisory Circular for Stall Prevention and Recovery Training.
3. NSP Guidance Bulletin 11-05 - FSTD Evaluation and Qualification for Upset Prevention and Recovery Training (UPRT) Tasks

For questions regarding this Guidance Bulletin or 14 CFR Part 60 Change 2, please call the FAA National Simulator Program at 404.474.5620.

Attachment 1

Functions and Subjective Evaluation for Full Stall Maneuvers

- A. An assessment of the FSTD's stall characteristics should be accomplished by a qualified subject matter expert (SME) pilot with direct experience in the stall characteristics of the aircraft being simulated or an aircraft that shares the same type rating as the make, model, and series of the simulated aircraft. This assessment should be complemented with aircraft OEM or other suitable documentation (such as flight test reports or aircraft certification data) that fully describes the stall characteristics of the simulated aircraft.
- B. The following stall entry conditions and aircraft configurations should be evaluated as necessary for training purposes:
 - a. Stall entry at wings level (1 g)
 - b. Stall entry in turning flight of at least 25° bank angle
 - c. Power-on stall entry (especially for propeller driven aircraft, but also for any aircraft where power effects significantly influence the wing and/or tail surfaces)
 - d. Aircraft configurations of second segment climb, high altitude cruise (near performance limited conditions), and approach or landing.
- C. For computer controlled aircraft (CCA), the FSTD should be evaluated in both “normal” and “non-normal” control modes. Reversion to degraded control laws (such as secondary, alternate, or direct control laws) should be conducted with consideration of potential failure scenarios that may be encountered in an operational environment or as necessary to support the operator's training requirements.
- D. In addition to the performance and handling characteristics, these additional aircraft characteristics and aircraft systems operations should be evaluated as applicable to the aircraft being simulated:
 - a. Stall warning/stick shaker onset speeds
 - b. Aircraft automation functionality (such as autopilot, auto throttle, or automatic stabilizer trim systems)
 - c. Pitch Limit Indication (PLI)/speed warning system functionality
 - d. Flight control effectiveness
 - e. Aircraft stability
 - f. Artificial control forces/load feel systems

- g. Automatic extension of leading edge devices (such as auto slat systems)
- h. Stall buffet
 - i. Stall buffet onset speed and relation to stall warning system activation and stall break
 - ii. Stall buffet intensity and growth rate
 - iii. Stall buffet characteristics (frequency and magnitude)
- i. Stall identification/stall protection systems (stick pusher/stick nudger/elevator feel shift system)
 - i. System activation speed/angle of attack
 - ii. System activation at high angle of attack rates
 - iii. Stick pusher force/ability to override pusher forces
 - iv. System cancellation logic
 - v. Characteristics of the stall
 - vi. Change in vertical speed and/or g-break
 - vii. Pitch break
 - viii. Flight control limitation
 - ix. Uncommanded roll/yaw
 - x. Deterrent buffet
- j. Stall Recovery
 - i. Thrust/drag relationship
 - ii. Engine effects on pitching moment
 - iii. Stall hysteresis
 - iv. Secondary stall/stall warnings
 - v. Representative altitude loss during stall recovery, particularly in high altitude performance limited conditions