CS-FSTD(A) issue 2 checklist

This checklist provides information on what is required from FFS level C and D devices to be qualified under CS-FSTD(A) issue 2. This checklist is prepared mainly with the focus on cases where an already qualified FFS is modified to be qualified under CS-FSTD(A) issue 2, so this list basically caters the differences between CS-FSTD(A) initial issue and issue 2. But this list can be used for initial FFS qualifications also.

This checklist tries to list all the individual required items and references to the applicable regulation. As a result, this document is too detailed (i.e. not user-friendly) to be used as a checklist during on-site evaluations in the FFS. However, this document can be used as an information source: further checklists can be created by just abbreviating the items of this list. It is up to each individual on how much items should be abbreviated.

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All the derivatives of this document and proposed changes to this document are requested to be sent to Traficom by using email address kirjaamo@traficom.fi with email subject 'Flight simulator UPRT qualification - CS-FSTD(A) issue 2 checklist'.

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Changes:

- 30 April 2019: publication of the first version.
- 16 July 2019: changes to paragraph 6.1.3 concerning requirements on the PFD on the IOS and on paragraph 4.3 concerning interpretation of a development simulator.
- 22 July 2019: further changes to paragraph 4.3 concerning interpretation of a development simulator; changes to paragraph 4.1 concerning reference to AMC11 FSTD(A).300; changes to paragraph 4.2 concerning requirements on pilots performing the assessment; and minor editorial changes.
- 16 Jan 2020: FSTD form number added to the footer.
- 30 Jan 2020: One typo corrected in paragraph 6.7.
- 7 Dec 2020: Table of contents was added. Typos were corrected. Wording in paragraphs 2 and 3.2 clarified. Email address reference on cover page corrected. Page breaks added to chapter 6 for each sub-paragraph to make reading easier.

Contents

1. INTRODUCTION

CS-FSTD(A) issue 2 implements technical requirement that support upset prevention and recovery training (UPRT). An aeroplane upset is an undesired aeroplane state characterized by unintentional deviations from parameters experienced during normal operations. An aeroplane upset may involve pitch and/or bank angle deviations as well as inappropriate airspeeds for the given conditions.

Updating a full flight simulator (FFS) from an older primary reference document (PRD) to CS-FSTD(A) issue 2 requires implementing the following main elements:

- Defining FSTD validation envelope
- Instructor station feedback tools
- Upset scenarios
- Increase fidelity of the approach-to-stall simulation by objective testing (and similarly for full stall which is voluntary but must fulfill the requirements if it is to be qualified)
- Increase the fidelity of the simulation of the engine and airframe icing effects

Note that an update of an FFS to be qualified under CS-FSTD(A) issue 2 is considered as a major update (see ORA.FSTD.110 and its AMC and GM).

It is important to understand that CS-FSTD(A) issue 2 offers the FSTD operator to make a choice whether to apply for option A or B below:

A. Device to be qualified for approach-to-stall only.
   The FSTD qualification certificate would not indicate anything, since this is the required fidelity level.
B. Device to be qualified for full stall.
   The FSTD qualification certificate would indicate full stall as an additional capability.

It is also important to understand that CS-FSTD(A) issue 2 enables to use different kind of validation methods for high angle of attack, approach to stall and stall model. Data sources may be from the aeroplane original equipment manufacturer (OEM), the original FSTD manufacturer/data provider, or other data providers acceptable to the competent authority (see for example AMC10 FSTD(A).300 paragraph (d)). Note that AMC11 FSTD(A).300 gives guidance to proceed if it is not possible to provide the required validation data for the new or revised objective test cases to support FSTD qualification for stall and approach to stall. In such cases, so called footprint method may be used. For the testing of the high-altitude cruise and turning-flight stall conditions, these manoeuvres may be subjectively evaluated by a qualified SME pilot (see AMC10 FSTD(A).300 paragraph (e)) and addressed in the required statement of compliance (SOC).

This checklist has been prepared by targeting that it is to be used by a pen. Each individual item to be checked has a box on the left. Checked items can be checked by a pen. Additional notes can be written next to items and/or under each section.

As always, it is the FSTD operator's responsibility to check and ensure compliance. The competent authority performs only **sampling** to ensure that the FSTD operator has fulfilled its obligation.

2. APPLICATION

The FSTD operator should deliver application and supportive documentation well in advance to the competent authority as listed below. Please note that some of the documents are expected to be part of the MQTG.

2.1 Application

The FSTD operator should prepare and file an application (see ORA.FSTD.230 paragraph (a)(1)). The application should indicate what the FSTD operator is requesting.

2.2 Description of the modification

ORA.FSTD.100 presents information regarding modifications to FSTD. The application should be amended with the description of the modification.

2.3 Management of change

See AMC1 ORA.GEN.200(a)(1);(2);(3);(5) paragraph (b) for non-complex organizations.
See AMC1 ORA.GEN.200(a)(3) paragraph (e) for complex organizations.

2.4 Evaluation personnel and their competency

Please provide information on who has evaluated different aspects of the device.

Please provide also evidence on their competency with CS-FSTD(A) issue 2. See ORA.GEN.200 paragraph (a)(4). The personnel associated with testing and maintaining the device must be adequately trained and competent with CS-FSTD(A) issue 2 and UPRT. For example, the maintenance representatives must be trained and competent to assess the new QTG tests. And the persons performing functional and subjective testing must be trained and competent to assess the device and its systems in applicable parts of the envelope for suitability to UPRT (see AMC9 FSTD(A).300 paragraph (a)(1)(i)).

2.5 Preventative maintenance program

It is expected that the FSTD will be subject to an increased training time with buffets. This will create more mechanical stress to different components (e.g. wiring, ‘waterfall’, panels, joints, etc.). It is also possible that the computer architecture changes. The maintenance program should already foresee such changes and take actions to ensure continued integrity of the device.

2.6 Technical specification

See GM3 ORA.FSTD.100 paragraph (c)(3).

2.7 Validated training envelope

The range of angle-of-attack (alpha) and sideslip (beta) where the aerodynamic model remains valid during training (see AMC10 FSTD(A).300 paragraph (d)(2)).

2.8 Applicable parts of the dossier for initial evaluation

See GM3 ORA.FSTD.100 paragraph (c)(3). If for example the AFM/FCOM of the simulated aircraft changes, the new applicable version should be delivered.

2.9 Functional and subjective testing records

See ORA.FSTD.110 paragraph (b).
See GM3 ORA.FSTD.100 paragraph (c)(3) for ‘acceptance test manual’ which means a comprehensive and signed documentation to show evidence of successfully having tested the whole device in details.
See CS-FSTD(A) issue 2 ‘Table of Functions and subjective tests’.
FSTDs that are used to conduct training manoeuvres where the FSTD is repositioned either into an aeroplane upset condition or an artificial stimulus (such as weather phenomena or system failures) that is intended to result in a flight crew entering an aeroplane upset condition, must be evaluated and qualified (see AMC12 FSTD(A).300 paragraph (a)(3)).

2.10 MQTG

MQTG should be revised to cater for example for:

- New QTG tests required by CS-FSTD(A) issue 2.
- Statements of compliance (SOC) are included in MQTG.
- FSTD information page will require changes.
- List of effective pages and log of test revisions
- Appendixes (e.g. primary reference document as required by AMC1 FSTD(A).300 paragraph (a)(6)(ii)(J).

2.11 Information on what scenarios, configurations and manoeuvres have been tested for training use

See AMC9 FSTD(A).300 paragraph (a)(4)(x). Please provide a copy of the documentation that will be provided to the instructors.

See AMC10 FSTD(A).300 paragraph (f) for details on the principles of testing:

- The necessity of subjective tests arises from the need to confirm that the simulation model has been integrated correctly and performs as declared in accordance with AMC10 FSTD(A).300 paragraph (d). It is vital to examine, for example, that the simulation validity range allows modelling continuity that is adequate to allow for the completion of stall recovery.
- The subjective tests of the simulation model should assess modelling continuity when slightly increasing the angle of attack beyond the validity range defined in AMC10 FSTD(A).300 paragraph (d)(2), e.g. CL max.
- The increase in angle of attack beyond the validity range CL max should be limited to a value not greater than the maximum angle achieved two seconds after stall recognition, which is sufficient to allow a proper recovery manoeuvre.

Notes on this whole section 2:

Are all the items in section 2 satisfactory?

- ☐ Yes
- ☐ No

Person responsible for assessing this section:

Name:
Date:
Signature:

3. STATEMENTS OF COMPLIANCE

Checks in this section are to be performed before the on-site evaluation. Therefore, there should be adequate time to go through all items. Hence, the checklist items are kept as long and comprehensive.

Statements of compliance (SOC) are part of the MQTG.

3.1 For all FFS level C and D devices

- ☐ A statement of compliance on **FSTD validation envelope**. See details in Appendix 1 to CS FSTD(A).300 table 1 item h.2 and also AMC12 FSTD(A).300: *"An SOC is required that defines the source data used to construct the FSTD validation envelope."*

  Note that '<u>FSTD training envelope</u>' means high- and moderate-confidence regions of the <u>FSTD validation envelope</u> (see AMC1 FSTD(A).200). See AMC12 FSTD(A).300 paragraph (b)(2) for detailed guidance on the three different regions of the FSTD validation envelope:
    A. flight-test-validated region (i.e. high confidence level)
    B. wind tunnel and/or analytical region (i.e. moderate confidence level)
    C. extrapolated region (i.e. low confidence level)

  Note that the validation envelope must be derived by the aerodynamic data provider, or using information and data sources provided by the aerodynamic data provider (see AMC12 FSTD(A).300 paragraph (c)(1)(i)).

- ☐ A statement of compliance on **upset scenarios**. See details in Appendix 1 to CS FSTD(A).300 table 1 item h.3 and also AMC9 FSTD(A).300(a)(1):
  "An SOC is required to confirm that each upset prevention and recovery feature programmed at the IOS and the associated training manoeuvre have been evaluated by a suitably qualified pilot."

- ☐ A statement of compliance on **ground effect**. See details in Appendix 1 to CS FSTD(A).300 table 1 item s.1 and AMC9 FSTD(A).300(a)(2).

- ☐ A statement of compliance on the **aerodynamic model**.

  - ☐ See details in Appendix 1 to CS FSTD(A).300 table 1 item s.2:
    "The aerodynamic model has to incorporate data representing the aeroplane's characteristics covering an angle of attack and sideslip range to support the training tasks."

  - ☐ See details in AMC9 FSTD(A).300(a)(3):
    "(i) for continuity purposes, the model should remain useable beyond the FSTD training envelope to the extent to allow completion of the recovery training; and (ii) where known limitations exist in the aerodynamic model for particular stall event manoeuvres (such as aeroplane configuration, approach-to-stall entry methods, and limited range for continuity of the modelling), <u>these limitations should be declared in the required SOC</u>."

  - ☐ Only if QTG test 3.g.(5) is not provided:
    This statement of compliance should confirm if the simulated aeroplane exhibits stall buffet before the activation of the stall warning system. That information defines if QTG test 3.g.(5) for stall buffet is applicable or not. See details in AMC1 FSTD(A).300 table item 3.g.(5).

- ☐ For aeroplanes authorized for **operations in icing conditions**:
  A statement of compliance to describe the effects that provide training in the specific skills for recognition of icing phenomena and execution of recovery. See details in Appendix 1 to CS FSTD(A).300 table 1 item t.1:
    "The SOC must describe the <u>source data and any analytical methods</u> used to develop ice accretion models, including a verification that these effects have been tested. // Aeroplane original equipment manufacturer (OEM) data or other acceptable analytical methods must be used to develop ice accretion models. Acceptable analytical methods may include wind tunnel analysis and/or engineering analysis of the aerodynamic effects of icing on the aeroplane lifting surfaces coupled with tuning and supplemental subjective assessment by a subject-matter expert pilot knowledgeable of the effect of ice accretion on the handling qualities of the simulated aeroplane."

  The previous quote is amended by AMC13 FSTD(A).300 paragraph (c)(2):

> "*<u>A description of the data sources</u> used to develop the qualified ice accretion models. Acceptable data sources may be but are not limited to flight test data, aeroplane certification data, aeroplane OEM engineering simulation data, or other analytical methods based on established engineering principles.*"

The SOC must contain <u>a description of expected aeroplane-specific recognition cues and degradation effects</u> due to a typical in-flight icing encounter. This is further explained by AMC13 FSTD(A).300 paragraph (c)(1):

> "*Typical cues may include loss of lift, decrease in stall angle of attack, changes in pitching moment, decrease in control effectiveness, and changes in control forces in addition to any overall increase in drag. This <u>description must be based on relevant data sources</u>, such as aeroplane OEM-supplied data, accident/incident data, or other acceptable data sources. Where a particular airframe has demonstrated vulnerabilities to a specific type of ice accretion (due to accident/incident history), which requires specific training (such as supercooled large-droplet icing or tailplane icing), ice accretion models must be developed that address those training provisions.*"

3.2 Only if required validation data is not possible to be provided to support qualification of previously qualified FFS for stall and/or approach-to-stall and a SME is used

In this case, the method described in AMC11 FSTD(A).300 may be used. Therefore, the following additional statements of compliance should be given:

- Documentation to **justify the need** to use method of AMC11 FSTD(A).300. Note that this is not to be included into the MQTG, but will be delivered to the authority as part of the documentation and dossier.

- A statement of compliance to address the **subjective evaluation methods** (e.g. manoeuvres) and **SME pilot** (see AMC10 FSTD(A).300 paragraph (b)). The SOC must identify the simulator (e.g. the simulator to be qualified, engineering simulator or development simulator) where the SME performed the stall characteristics evaluation. This information is needed to know if requirement of 'proof-of-match' tests is applicable (see AMC11 FSTD(A).300 paragraph (e)).

3.3 Only for the FFS level C and D devices to be qualified for full stall training tasks

- A statement of compliance on **stick pusher**. See details in Appendix 1 to CS FSTD(A).300 table 1 item g.2: "*A statement of compliance (SOC) is required verifying that the stick pusher system has been modelled, programmed, and <u>validated</u> using the aeroplane manufacturer's design data or other acceptable data source. The SOC must address, at a minimum, the stick pusher activation and cancellation logic as well as system dynamics, control displacement and forces as a result of the stick pusher activation.*"

- A statement of compliance on **aerodynamic modelling** methods, validation and check of the stall characteristics of the FSTD. See details in Appendix 1 to CS FSTD(A).300 table 1 item s.3 and AMC9 FSTD(A).300(a)(4).

- A statement of compliance on the **aerodynamic model** must include:
  - Confirmation and information (e.g. sources of data) listed in AMC10 FSTD(A).300 paragraph (d)(1):
    - The SOC must identify the <u>sources of data</u> used to develop the aerodynamic model. These data sources may be from the aeroplane original equipment manufacturer (OEM), the original FSTD manufacturer/data provider, or other data providers acceptable to the competent authority.
    - Of particular interest is a mapping of test points in the form of an <u>alpha/beta envelope</u> plot for a minimum of flaps-up and flaps-down aeroplane configurations.
    - For the flight test data, a <u>list of the types of manoeuvres</u> used to define the aerodynamic model for angle of attack ranges greater than the first indication of stall must be provided per flap setting.
    - Flight test reports, when available, <u>describing stall characteristics</u> of the aeroplane type being modelled, issued by the OEM or flight test pilot, can be referred to.
    - In cases where it is impractical to develop and validate a stall model with flight-test data (e.g. due to safety concerns involving the collection of flight-test data past a certain angle of attack), the data provider is expected to make a reasonable attempt to develop a stall model through the required angle of attack range using analytical methods and empirical data (e.g. wind-tunnel data).
  - Confirmation and information (e.g. stall model characteristics) listed in AMC10 FSTD(A).300 paragraph (d)(3) where applicable by aeroplane type:
    - i. degradation of the static/dynamic lateral-directional stability
    - ii. degradation in control response (pitch, roll, and yaw)
    - iii. uncommanded roll acceleration or roll-off requiring significant control deflection to counter

- iv. apparent randomness or non-repeatability
- v. changes in pitch stability
- vi. stall hysteresis
- vii. Mach effects
- viii. stall buffet
- ix. angle of attack rate effects

An overview of the methodology used to address these features must be provided.

- A statement of compliance to verify that the simulation model has been **subjectively evaluated by a subject matter expert (SME)** acceptable to the competent authority. See details in AMC10 FSTD(A).300 paragraph (e) and in Appendix 1 to CS FSTD(A).300 table 1 item s.3 and AMC10 FSTD(A).300(e).

  The SOC should give evidence that the SME meets the criteria of AMC10 FSTD(A).300 paragraph (e). Note that if the SME's stall experience is in an aeroplane of a different make, model, and series within the same type rating, differences in aeroplane-specific stall recognition cues and handling characteristics must be addressed using available documentation (see details in AMC10 FSTD(A).300 paragraph (e)(3)).

  Note that this SOC may be prepared for example by the SME of the OEM for example in an engineering simulator. Therefore, the SOC should state also that the same stall model has been implemented in this individual FFS in question and that the stall training tasks can be successfully accomplished.

- A statement of compliance on **subjective tests**. See details in AMC10 FSTD(A).300 paragraph (f), such as: "*Where known limitations exist in the aerodynamic model for particular stall event manoeuvres (such as aeroplane configuration, approach-to-stall entry methods, and limited range for continuity of the modelling), these limitations must be declared in the required SOC.*"

- A statement of compliance on **sounds**. See details in Appendix 1 to CS FSTD(A).300 table 4 item b.1.

Notes on this whole section 3:

Are all the items in section 3 satisfactory?

- Yes
- No

Person responsible for assessing this section:

Name:

Date:

Signature:

4. NEW QTG TESTS REQUIRED BY CS-FSTD(A) issue 2

Checks in this section are to be performed before the on-site evaluation. Therefore, there should be adequate time to go through all items. Hence, the checklist items are kept as long and comprehensive.

4.1 For all FFS level C and D devices

- ☐ **QTG test 2.i.(1). Engine and airframe icing effects demonstration (high angle of attack).**
  See details in AMC1 FSTD(A).300 table 2 item i.(1).

  Note that for previously qualified devices (i.e. where the primary reference document remains the same but UPRT items are just updated to meet CS-FSTD(A) issue 2), these QTG tests are not required (see AMC11 FSTD(A).300 paragraph (f)), but icing is only assessed via SOC and subjective evaluation.

  Check that tests are within tolerances.

  The test must demonstrate the matters listed in AMC9 FSTD(A).300 paragraph (b)(3):
  - ☐ Two tests are required to demonstrate engine and airframe icing effects. One test demonstrates the FSTDs baseline performance without ice accretion, and the second test demonstrates the aerodynamic effects of ice accretion relative to the baseline test. (See also AMC13 FSTD(A).300 paragraph (d).)
  - ☐ Tests should show time history from a trimmed flight condition through approach-to-stall or full stall (see AMC13 FSTD(A).300 paragraph (d)(2)), and of the initiation of the recovery (see AMC9 FSTD(A).300 paragraph (b)(3)). Note that full stall is applicable only for those FSTDs that are to be qualified for full stall training tasks.
  - ☐ QTG tests with ice accretion are compared to a baseline (no ice build-up) test.
  - ☐ The ice accretion models must demonstrate the cues necessary to recognise the onset of ice accretion on the airframe, lifting surfaces, and engines, and provide a representative degradation in performance and handling qualities to the extent that a recovery can be executed
  - ☐ Flight test validation data is not required for full stall test (see AMC9 FSTD(A).300 paragraph (b)(3)(i)).
  - ☐ The QTG and/or SOC test must identify the ice accretion model that is used in the QTG test (see AMC13 FSTD(A).300 paragraph (d)(2)).
  - ☐ The demonstration manoeuvre test may be conducted by initialising and maintaining a fixed amount of ice accretion throughout the manoeuvre in order to consistently evaluate the aerodynamic effects (see AMC13 FSTD(A).300 paragraph (d)(2)).
  - ☐ The test must utilize the icing model(s) as described in the SOC required in Appendix 1 to CS FSTD(A).300 item 1.t.1. The test must include a rationale that describes the icing effects being demonstrated. Icing effects may include, but are not limited to, the following effects, as applicable to the particular aeroplane type (see also AMC13 FSTD(A).300 paragraph (d)(2)):
    - ☐ A. decrease in the stall angle of attack
    - ☐ B. increase in stall speed
    - ☐ C. changes in the pitching moment
    - ☐ D. decrease in control effectiveness
    - ☐ E. changes in control forces
    - ☐ F. increase in drag
    - ☐ G. changes in stall buffet characteristics
    - ☐ H. increase in stall buffet threshold perception speed
    - ☐ I. engine effects (power reduction/variation, vibration, etc. where expected to be present on the aeroplane in the ice accretion scenario being tested)
  - ☐ Tests are evaluated for representative effects on relevant aerodynamic and other parameters, such as angle of attack, control inputs, and thrust/power settings.
  - ☐ Recorded parameters (in the validation test result) should include the following (see AMC13 FSTD(A.300 paragraph (d)(1)):
    - ☐ A. altitude
    - ☐ B. airspeed
    - ☐ C. normal acceleration
    - ☐ D. engine power/settings
    - ☐ E. angle of attack
    - ☐ F. pitch attitude
    - ☐ G. bank angle
    - ☐ H. flight control inputs
    - ☐ I. stall warning and stall buffet onset
    - ☐ J. other parameters necessary to demonstrate the effects of ice accretion

4.2 For FFS level C and D devices to be qualified for approach-to-stall training tasks

- ☐ **QTG test 2.b.(8b). Stall characteristics.**
  See details in AMC1 FSTD(A).300 table item 2.b.(8b).

3 different flight conditions are expected:
- Second segment climb
- High-altitude cruise near performance limited condition. (This may be a footprint test created in accordance with AMC11 FSTD(A).300.)
- Approach or landing

For computer-controlled aeroplanes (CCA):
- test in normal and non-normal control states. So in case of CCA, there should be 6 tests in total.

Check that tests are within tolerances.

The test must demonstrate the matters listed in AMC9 FSTD(A).300 paragraph (b)(2):
- Control displacements and flight control surfaces must be plotted and demonstrate correct trend and magnitude.
- Each of the following stall entries must be demonstrated in at least one of the three flight conditions (see Table of FSTD Validation Test, 8(b)):
  - (A) approach-to-stall entry at wings level (1g).
  - (B) approach-to-stall entry in turning flight of at least 25° bank angle (accelerated stall). (If validation data is not available, this may be a footprint test created in accordance with AMC11 FSTD(A).300.)
  - (C) approach-to-stall entry in a power-on condition (required only for propeller-driven aeroplanes).
- The cruise flight condition must be conducted in a flaps-up (clean) configuration.
- The second-segment climb flight condition must use a different flap setting than for the approach or landing flight condition.
- For computer-controlled aeroplanes (CCAs) with stall envelope protection systems, the normal-mode testing is only required at an angle of attack range necessary to demonstrate the correct operation of the system. These tests may be used to satisfy the required (angle of attack) flight manoeuvre and envelope protection tests of AMC1 FSTD(A).300 paragraph (2)(h).

Only if required validation data is not possible to be provided to support qualification of previously qualified FFS (see AMC11 FSTD(A).300):
- Objective testing in accordance with the old primary reference document (for example CS-FSTD(A) initial issue) is required for the (wings level) second-segment climb and approach or landing flight conditions (see AMC11 FSTD(A).300 paragraph (a)).
- For the testing of the high-altitude cruise and turning-flight stall conditions, these manoeuvres may be subjectively evaluated by a *suitably qualified* pilot (note that *SME* is required for full stall, as can be seen in the wording in CS-FSTD(A) issue 2) and addressed in the required statement of compliance (SOC). These tests should utilize the footprint method.
- Where existing flight test validation data in the FSTD's MQTG is missing required parameters, or is otherwise unsuitable to fully meet the objective testing provisions, the competent authority may accept alternative sources of validation (see AMC11 FSTD(A).300 paragraph (c)).

- **QTG test 3.g.(5). Motion stall buffet.**
  This test is required only if the the simulated aeroplane exhibits stall buffet before the activation of the stall warning system: See details in AMC1 FSTD(A).300 table item 3.g.(5).

4.3 Only for the FFS level C and D devices to be qualified for full stall training tasks

- **QTG test 2.a.(10). Stick pusher system force calibration.**
  See details in AMC1 FSTD(A).300 table item 2.a.(10).

- **QTG test 2.b.(8a). Stall characteristics.**
  See details in AMC1 FSTD(A).300 table item 2.b.(8a):
  - 3 different flight conditions are expected:
    - Second segment climb
    - High-altitude cruise near performance limited condition. (This may be a footprint test created in accordance with AMC11 FSTD(A).300.)
    - Approach or landing
  - For computer-controlled aeroplanes (CCA) with stall envelope protection systems: test in normal and non-normal control states. So in case of CCA, there should be 6 tests in total.
  - In normal control state, it is expected that envelope protections will take effect, and it may not be possible to reach the aerodynamic stall condition for some aeroplanes. The test is only required for an angle of attack range necessary to demonstrate the correct operation of the system.
  - In non-normal state, it is necessary to perform the test to the aerodynamic stall. It is understood that flight test data may not be available and, in this circumstance, engineering validation data may be used and the extent of the test should be adequate to allow training through to recovery, in accordance with the training objectives. For safety of flight considerations, the flight test data may be limited to the stall angle

of attack, and the modelling beyond the stall angle of attack is only required to ensure it is limited to continuity and completion of the recovery.

- The test is expected to be performed with motion system ON, to evaluate the buffet (see test tolerances and AMC9 FSTD(A).300 paragraph (b)(1)(viii).

Check that tests are within tolerances.

- Guidance on tolerances are presented in AMC10 FSTD(A).300 paragraph (b):
  "*The provisions for high angle of attack modelling should be applied to evaluate the recognition cues as well as performance and handling qualities of a developing stall through the stall identification angle of attack and stall recovery. Strict time-history-based evaluations against flight test data may not adequately validate the aerodynamic model in an unsteady and potentially unstable flight regime, such as stalled flight. As a result, the objective testing provisions of AMC1 FSTD(A).300 do not contain strict tolerances for any parameter at angles of attack beyond the stall identification angle of attack. In lieu of mandating such objective tolerances, an SOC should define the source data and methods used to develop the aerodynamic stall model*."
- Numerical tolerances are not applicable past the stall angle of attack, but must demonstrate correct trend through recovery (see AMC9 FSTD(A).300 paragraph (b)(1)(v)).

Check that the tests fulfill requirements of AMC9 FSTD(A).300 paragraph (b)(1):

- Control inputs must be plotted and demonstrate correct trend and magnitude.
- Each of the following stall entries must be demonstrated in at least one of the three flight conditions (see Table of FSTD Validation Test, 8(a)):
    - (A) stall entry at wings level (1g).
    - (B) stall entry in turning flight of at least 25° bank angle (accelerated stall). (If validation data is not available, this may be a footprint test created in accordance with AMC11 FSTD(A).300.)
    - (C) stall entry in a power-on condition (required only for propeller-driven aeroplanes).
- The cruise flight condition must be conducted in a flaps-up (clean) configuration.
- The second-segment climb flight condition must use a different flap setting than for the approach or landing flight condition.
- The stall warning signal and initial buffet, if applicable, must be recorded.
- Time-history data must be recorded for a full stall through recovery to normal flight.
- The stall warning signal must occur in the proper relation to buffet/stall.
- FSTDs of aeroplanes exhibiting a sudden pitch attitude change or 'g break' must demonstrate this characteristic.
- FSTDs of aeroplanes exhibiting a roll-off or loss-of-roll control authority must demonstrate this characteristic.
- For aeroplanes with stall envelope protection systems, the normal-mode testing is only required at an angle of attack range necessary to demonstrate the correct operation of the system. These tests may be used to satisfy the required (angle of attack) flight manoeuvre and envelope protection tests of AMC1 FSTD(A).300. Non-normal control states must be tested through stall identification and recovery.
- Buffet threshold of perception should be based on 0.03 g peak to peak normal acceleration above the background noise at the pilot seat. Initial buffet to be based on normal acceleration at the pilot seat with a larger peak to peak value relative to buffet threshold of perception (some airframe manufacturers have used 0.1 g peak to peak). Demonstrate correct trend in growth of buffet amplitude from initial buffet to stall speed for normal and lateral acceleration.
- The maximum buffet may be limited based on motion platform capability/limitations or other simulator system limitations. If the maximum buffet is limited, the limit should be sufficient to allow proper use in training (e.g. not less than 0.5 g peak to peak), and in any case the instructor should be informed of the limitations.
- Tests may be conducted at centres of gravity (CG) and weights typically required for aeroplane certification stall testing.

Check that these requirements are fulfilled if flight test validation data is not available nor used:

- In instances where flight test validation data is limited due to safety-of-flight considerations, engineering simulator validation data may be used in lieu of flight test validation data for angles of attack that exceed the activation of a stall protection system or stick pusher system. (See AMC9 FSTD(A).300 paragraph (b)(1)(vii).)
- Where approved engineering simulation validation is used, the reduced engineering tolerances (as defined in Appendix 1 to AMC1 FSTD(A).300 paragraph (b) as 20% of normal tolerances) do not apply. (See AMC9 FSTD(A).300 paragraph (b)(1)(xiii).)

Only if required validation data is not possible to be provided to support qualification of previously qualified FFS (see AMC11 FSTD(A).300):

- Objective testing in accordance with the old primary reference document (for example CS-FSTD(a) initial issue) is required for the (wings level) second-segment climb and approach or landing flight conditions (see AMC11 FSTD(A).300 paragraph (a)).
- For the testing of the high-altitude cruise and turning-flight stall conditions, these manoeuvres may be subjectively evaluated by a qualified SME pilot (see AMC10 FSTD(A).300 paragraph (e)) and addressed in the required statement of compliance (SOC). These tests should utilize the footprint method to document the SME evaluation.

- Where existing flight test validation data in the FSTD's MQTG is missing required parameters, or is otherwise unsuitable to fully meet the objective testing provisions, the competent authority may accept alternative sources of validation, including subjective validation by an SME pilot with direct experience in the stall characteristics of the aeroplane (see AMC11 FSTD(A).300 paragraph (c)).
- Only if the stall characteristics have been subjectively evaluated by an SME pilot on an engineering simulator or development simulator (see AMC11 FSTD(A).300 paragraph (e)):
  - Objective 'proof-of-match' testing for all flight conditions, as described in Tests 2.c.(8a) and 3.g.(5), is required to verify the implementation of the stall model and stall buffets on the FFS to be qualified. (Note that the words 'all flight conditions' mean all stall test cases.)

    Note that the words 'development simulator' have not been clearly defined in CS-FSTD(A) issue 2. It is considered to mean a device that has been qualified as an FFS (with motion sufficient to represent stall buffet) and acts as the device in which the stall model is being assessed and tested by the SME and where the footprints of stall model are conducted.

  - QTG results for 2.c.(8a) and 3.g.(5) for all flight conditions should be provided from the engineering or development simulator.
    - Notice the definition of 'proof-of-match' in AMC1 FSTD(A).300. By comparing the results of the engineering or development simulator with the test results from the FFS to be qualified, it should be seen that the models should essentially match (see AMC8 FSTD(A).300 paragraph (b)(5)). This is the proof-of-match concept.
  - The QTG results from the engineering or development simulator (i.e. proof-of-match data) is part of the source data and hence it should be attached to the MQTG as references (see AMC1 FSTD(A).300 paragraph (a)(6)(I) items (d) and (k)).

- **QTG test 3.g.(5). Motion stall buffet.**
  See details in AMC1 FSTD(A).300 table item 3.g.(5).
  If required validation data is not possible to be provided to support qualification of previously qualified FFS and a SME is used (see AMC11 FSTD(A).300 paragraph (d)):
  - This test does not have to fulfill CS-FSTD(A) issue 2 requirements.
  - The results of the existing tests (i.e. in accordance with old primary reference document) must be provided to the competent authority with the updated stall and stall buffet models in place.

Notes on this whole section 4:

Are all the items in section 4 satisfactory?
- ☐ Yes
- ☐ No

Person responsible for assessing this section:

Name:

Date:

Signature:

5. ON-SITE QTG RE-RUN TESTING

Checks in this section are to be performed during the on-site evaluation. Therefore, there is a time constraint and the checklist must be easily readable. Hence, the checklist items are kept as short and descriptive only to enhance readability.

Perform sampling of new QTG tests required by CS-FSTD(A) issue 2 both in automatic and manual test mode. Check:

- ☐ Perform sampling of those tests that are not revised due to this update. Check that their results remain unaffected.
- ☐ Perform sampling of the tests that are revised because of this update.
- ☐ Randomness (e.g. in bank angle) in QTG tests 2.b.(8a) and 2.b.(8b). Apply engineering judgement to ensure that the key characteristics are maintained.
- ☐ List of tests performed during the on-site evaluation:

Notes on this whole section 5:

Are all the items in section 5 satisfactory?

- ☐ Yes
- ☐ No

Person responsible for assessing this section:

Name:
Date:
Signature:

6. ON-SITE FUNCTIONAL AND SUBJECTIVE EVALUATION

Checks in this section are to be performed during the on-site evaluation. Therefore, there is a time constraint and the checklist must be easily readable. A more practical (i.e. user-friendly) checklist can be generated from the items and descriptions below.

6.1 IOS tools

This paragraph includes checking of IOS tools. All the individual requirements are listed. So while this paragraph is long, individual items can be quickly checked and ticked.

This section concentrates on checking that the appropriate data and parameters for applicable configurations are presented. The latter sections list also operational items associated to the IOS tools.

- ☐ Upset prevention and recovery training (UPRT) tools on the instructor operator station (IOS):
  - ☐ The tools should be available at any time (e.g. for upset prevention training purposes), not only when upset manoeuvre is selected (see AMC12 FSTD(A).300 paragraph (c)(1)).
  - ☐ The objective of the IOS feedback during UPRT exercises is to provide the instructor with the ability to assess the timely and proper control action, including sequence, to complete the recovery in a safe manner (see GM12 FSTD(A).300 paragraph (a)).
  - ☐ The tools may be on a separate mobile device, rather than on the IOS display (see GM12 FSTD(A).300 paragraph (b)).
  - ☐ All data recorded for the use in the UPRT debrief should be easily permanently deleted after the UPRT training event (see GM12 FSTD(A).300 paragraph (b)).
- ☐ Check the usability and visibility of the real-time feedback tools (see Appendix 1 to CS FSTD(A).300 table 1 item h.2).

6.1.1 FSTD validation envelope

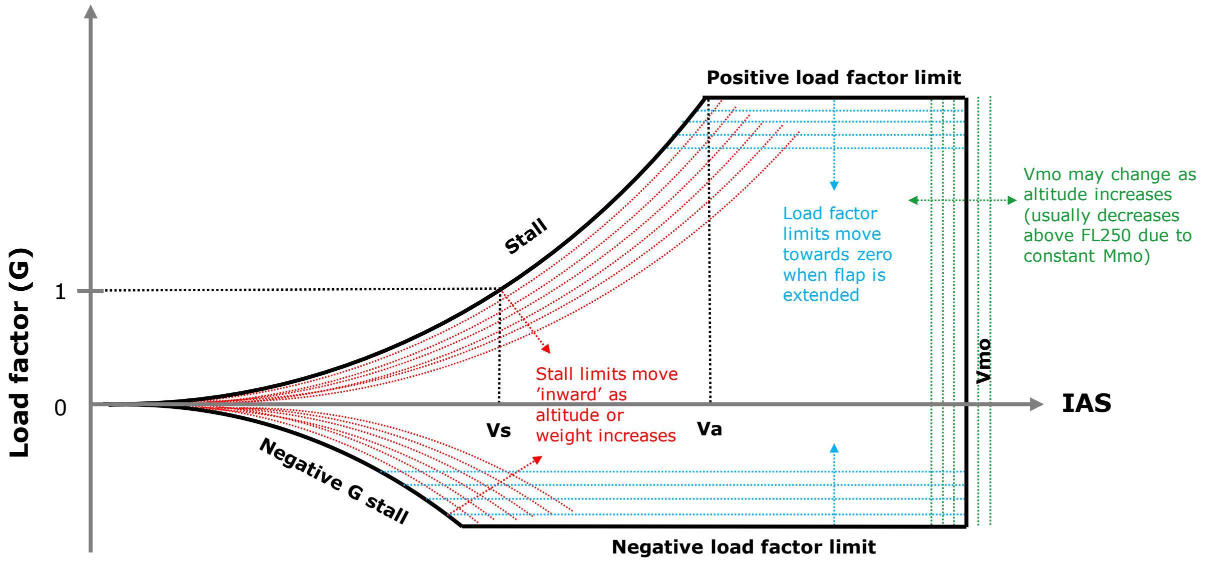
Feedback tools must include the FSTD validation envelope to clearly convey the FSTD's fidelity level during the manoeuvre. The envelope must be in the form of angle-of-attack versus sideslip (alpha/beta) cross-plot or alternative method as a minimum for:

- ☐ flaps-up (see details in Appendix 1 to CS FSTD(A).300 table 1 item h.2)
- ☐ flaps-down (see details in Appendix 1 to CS FSTD(A).300 table 1 item h.2)
- ☐ all three confidence regions: high, moderate and low (see AMC12 FSTD(A).300 paragraph (c)(1)(i) and Appendix 1 to CS FSTD(A).300 table 1 item h.2)

6.1.2 V-n diagram

Feedback tools must include Aeroplane operational limits, i.e. V-n diagram (see AMC12 FSTD(A).300 paragraph (c)(1)(iii)):

- ☐ Aeroplane operational limits to <u>all configurations</u>. (See details in Appendix 1 to CS FSTD(A).300 table 1 item h.2. Note that the paragraphs uses words "...as applicable for the configuration..." so it is interpreted to mean all configurations.)
- ☐ Displayed dynamically in real-time
- ☐ Time history (or equivalent format)
- ☐ As a minimum, the following parameters should be presented:
  - ☐ Airspeed
  - ☐ Airspeed limits, including the stall speed and maximum operating limit airspeed (VMO)/maximum operating Mach (MMO)
  - ☐ Load factor (G-loading)
  - ☐ Operational load factor limits
  - ☐ Angle of attack and stall identification angle of attack. This parameter may be displayed in conjunction with the FSTD validation envelope.



- ☐ Check V-n diagram limits changing to correct directions (as depicted in figure) when configuration, altitude or weight is changed.
- ☐ Check V-n diagram (IOS) vs. AFM Limitations section or TCDS and fill the tables:

For clean configuration:

	AFM	IOS
Positive load factor		
Negative load factor		
Vmo at FL100		
Vmo at FL250		
Vmo at FL350		
Va at FL100		
Va at FL250		
Va at FL350		
Vs1		

Data added to table is based on AFM pages: ……………………………

For other configurations:

Flap lever pos	Max speed		Positive load factor limit		Negative load factor limit		Vs1	
	AFM	IOS	AFM	IOS	AFM	IOS	AFM	IOS

Data added to table is based on AFM pages: ……………………………

6.1.3 Primary flight parameters

Feedback tools must include the primary flight parameters (see GM12 FSTD(A).300 paragraph (c)(2)):

- If the simulated aircraft is equipped with a Primary Flight Display (PFD), then the IOS shall display a PFD also and the parameters shall be the same as the ones displayed on the aeroplane PFD.

  Note EASA's interpretation on this:
  EASA has expressed to the national aviation authorities that an exact PFD is NOT required but the necessary information for instructor feedback should be available as stated in AMC12 FSTD(A).300: "Instructor feedback: provides the instructor/evaluator with the minimum set of feedback tools to properly evaluate the trainee's performance in accomplishing a UPRT task." This is dependent on aircraft type and the main CAE IOS pages need to be able to provide tailored information in order to assess the exercise. Under GM12 FSTD(A).300 (that is additional guidance) there are parameters for the PFD described and whilst not all parameters (as an example VMO) are shown on the PFD, as long as the parameters are available on the other IOS plot pages being used in the UPRT scenario then this is acceptable.

- Displayed parameters:
  - Pitch attitude
  - Roll attitude
  - Turn/sideslip
  - Indicated airspeed
  - Stall warning speed/stall buffet speed
  - VMO/MMO
  - Altitude
  - Rate of climb
  - Autopilot status
  - Auto-throttle status

6.1.4 Pilot inputs

Feedback tools must include the pilot inputs:

- Flight control displacements (pitch, roll and rudder pedal) (see Appendix 1 to CS FSTD(A).300 table 1 item h.2 and AMC12 FSTD(A).300 paragraph (c)(1)(ii) and GM12 FSTD(A).300 paragraph (c)(1))
- Flight controls forces (pitch, roll and rudder pedal) (see Appendix 1 to CS FSTD(A).300 table 1 item h.2 and AMC12 FSTD(A).300 paragraph (c)(1)(ii))
- Flight control law mode for fly-by-wire aeroplanes (see AMC12 FSTD(A).300 paragraph (c)(1)(ii))
- Throttles
- Flaps
- Speed brake
- Spoilers
- Time history of all above listed items (see AMC12 FSTD(A).300 paragraph (c)(1)(ii) and GM12 FSTD(A).300 paragraph (c)(1))
- Check that the sampling frequency rate is sufficiently high so that the display indicates also abrupt pilot inputs (see GM12 FSTD(A).300 paragraph (c)(1))

Note that for passive side-sticks, whose displacement is the flight control input, the force applied by the pilot to the controls does not need to be displayed (see AMC12 FSTD(A).300 paragraph (c)(1)(ii)).

6.1.4 Recording mechanism

- Check recording mechanism if such is utilized (see Appendix 1 to CS FSTD(A).300 table 1 item h.2).
- If a recorded feedback mechanism is installed (e.g. for debriefing in a briefing room outside the FFS), check its operation (see AMC12 FSTD(A).300 paragraph (c)(2)).

6.2 Upset scenarios

This paragraph includes checking of preset upset scenarios. Check that all required cases are simulated as required.

- ☐ Check that at least the following scenarios are available (see AMC9 FSTD(A).300 paragraph (a)(2)):
  - ☐ Nose-high with wings level
  - ☐ Nose-low
  - ☐ High bank-angle
- ☐ IOS must provide guidance on the method used to drive the FSTD into an upset condition, including any malfunction or degradation of the FSTD's functionality, required to initiate the upset. (See Appendix 1 to CS FSTD(A).300 table 1 item h.3.) Note that the guidance may also be in a manual (see AMC12 FSTD(A).300 paragraph (b)(1)(iii)).
- ☐ Check that there is no unrealistic degradation of simulator functionality (such as degrading flight control effectiveness). (See Appendix 1 to CS FSTD(A).300 table 1 item h.3 and AMC9 FSTD(A).300 paragraph (a)(1)(iii).). So the flight controls should be effective even during the upset (e.g. wake turbulence simulation).
- ☐ For flight-envelope-protected aeroplanes: check that the upsets do not incorrectly affect the control laws (see AMC9 FSTD(A).300 paragraph (a)(1)(iv)).
- ☐ Check handling characteristics. Sample upset scenarios by varying:
  - ☐ Different configurations (flap/slat and gear)
  - ☐ Altitudes; less aerodynamic damping at high altitudes
  - ☐ Different airspeeds
  - ☐ Stability augmentation on/off (e.g. yaw damper on/off)
  - ☐ Flight controls modes/states (e.g. normal law, alternate law and direct law for Airbus aeroplanes)
  - ☐ Quick pilot reactions to recover from upset
  - ☐ Slow pilot reactions to recover from upset; check how easy it is to regain control
  - ☐ Free responses (i.e. no pilot action at all to see the attitude trend and aerodynamic phenomena)
- ☐ Check that recovery from preset upset scenarios can be accomplished within the training envelope, i.e. within high and moderate confidence level regions (see AMC9 FSTD(A).300 paragraph (a)(1)(ii)).
- ☐ Check upset prevention and recovery by using all three different confidence level regions of the validated training envelope (see CS-FSTD(A) issue 2 'Table of functions and subjective tests' item f.1). So intentionally fly to low confidence region (i.e. extrapolated region) to check that the FSTD is still within the realms of confidence in the simulation accuracy (see AMC9 FSTD(A).300 paragraph (a)(1)(ii)).

6.3 Icing

See principles on the training aspects in AMC13 FSTD(A).300 paragraph (b). In short:

- ☐ Icing models must be able to train the specific skills required for the recognition of ice accumulation and for generating the required response.
- ☐ Icing models must contain aeroplane-specific recognition cues.

Icing simulation is applicable only for aeroplanes authorized for operations in known icing conditions.

Check IOS selection and display for icing:

- ☐ Different rates of icing, e.g. light, moderate, severe (see 'Table of functions and subjective tests' item p.2)
- ☐ Check that ice accumulates only if the atmospheric conditions support that, i.e. temperature and moisture (see Appendix 1 to CS FSTD(A).300 table 1 item l.1)

Test scenario (see 'Table of functions and subjective tests' item p.2):

- ☐ A. Initial conditions: stabilized level flight, autopilot on, autothrust off, anti-ice/de-ice system off
- ☐ B. Select icing from IOS at a rate that allows monitoring of the FSTD and system response.
- ☐ C. Check for (see 'Table of functions and subjective tests' item p.2):
  - ☐ Airspeed decay
  - ☐ Change in pitch attitude
  - ☐ Change in engine performance (other than due to airspeed change)
  - ☐ Change in data from pitot/static system
  - ☐ Instrument indications respond appropriately to icing effects (Appendix 1 to CS FSTD(A).300 table 1 item d.3).
- ☐ D. Aerodynamic effects and phenomena (see Appendix 1 to CS FSTD(A).300 table 1 item t.1), such as:
  - ☐ Loss of lift
  - ☐ Increase in drag
  - ☐ Decrease in stall angle of attack
  - ☐ Change in pitching moment
  - ☐ Decrease in control effectiveness
  - ☐ Changes in control forces
- ☐ E. Check stall protection system after ice has accumulated
- ☐ F. Check auto flight system with ice accretion (see Appendix 1 to CS FSTD(A).300 table 1 item t.1)
- ☐ G. Activate heating, anti-ice or de-ice systems independently.
- ☐ H. Check system indications and synoptics (e.g. de-ice cycle timing, ice detection system, etc.)
- ☐ I. Check that aeroplane eventually returns to normal flight (i.e. initial performance values) after anti-ice/de-ice systems have removed ice.

Check icing effects (see Appendix 1 to CS FSTD(A).300 table 1 item t.1) on:

- ☐ Airframe
- ☐ Engine(s)
- ☐ Systems behave correctly:
  - ☐ Stall protection system
  - ☐ Auto flight system
- ☐ Check the **type specific matters**. Review AFM and statements of compliance to see what type specific phenomena are to be expected. Test their existence subjectively. Describe the expected matters below:

6.4 Unusual parts of the flight envelope, i.e. UPRT manoeuvres

Note that evaluation of aeroplane stability (e.g. free responses and response to small/large control inputs) should be performed in 'normal' recurrent evaluations. If deemed as necessary, such evaluation should still be included in UPRT special evaluations. See AUPRTA paragraph 6.4.3.

Note that recommended UPRT flight training exercises are listed in AUPRTA section 8. More ideas can be raised from those exercises. The below listed checks are such items that would be testing the upset region of the flight envelope:

- ☐ Windshear / microburst (see AUPRTA paragraph 5.1.1.1)
- ☐ Flight control and other anomalies (see AUPRTA paragraph 5.2.3), such as:
  - ☐ Flap asymmetry
  - ☐ Spoiler failure
- ☐ Autopilot response to an instrument failure (see AUPRTA paragraph 5.2.1)
- ☐ Use of wrong AP mode (e.g. too high vertical speed) to enter upset (see AUPRTA paragraph 5.4)
- ☐ Intentional sideslip (see AUPRTA paragraph 6.4.2):
  - ☐ Check for realistic rolling moment depending on rudder size, wing dihedral and sweep angle.
  - ☐ Check that by releasing the controls, the aeroplane returns to zero sideslip.
  - ☐ Tested configuration ……………… and airspeed ………………
- ☐ Minimum control speed in air (Vmca)
  - ☐ Check flying intentionally below Vmca in OEI situation. Check for realistic and type specific yaw and rolling moments. Tested configuration: ………………
- ☐ Crossover speed (see AUPRTA paragraph 6.4.2.4):
  - ☐ 'Simulate' a rudder servo runaway failure by pressing one pedal to the bottom. Keep wings level and reduce airspeed. At certain airspeed/AoA the roll controller (e.g. aileron) is no longer effective enough to keep wings level. The aeroplane will enter a spiral.
  - ☐ Perform the same but with a recovery (while still holding pedal in the bottom). Only by unloading (i.e. reducing Aoa and increasing airspeed), the aeroplane control can be maintained.
- ☐ Roll efficiency vs. angle of attack (i.e. push/pull)
  Roll the aircraft to about 90 deg bank angle (e.g. like a wake vortex). Perform two different recoveries:
  - ☐ Max roll input with simultaneous pulling of the pitch control (i.e. loading). The roll rate should be low.
  - ☐ Max roll input with simultaneous pushing of the pitch control (i.e. unloading). The roll rate should be much quicker.
- ☐ Auto-flight control system reaction operation to an upset (see CS-FSTD(A) issue 2 'Table of functions and subjective tests' item f.1)
- ☐ Deliberately exceed Vmo/Mmo. The simulation should not crash from a slight exceedance.
- ☐ Deliberately exceed G limits. The simulation should not crash from a slight exceedance.
- ☐ If the installed data is built to fulfill FAA Part-60 requirements, check that those additional changes do not negatively affect training (e.g. bounced landing).

6.5 Stick pusher (if installed)

- ☐ Check ground test
- ☐ Check control forces, displacement, and surface positions.
  - ☐ If the device is to be qualified to approach-to-stall, the stick pusher is evaluated only by using functional and subjective testing methods.
  - ☐ If the device is to be qualified to full stall training tasks, the stick pusher is validated by SOC and QTG tests also.

6.6 Approach-to-stall

Note that full stall will be subjectively evaluated, even if it is not applied to be qualified. This is because of AMC1 FSTD(A).300 paragraph (c)(1)(ii) represents that "…*the subjective testing should cover those areas of the envelope which may reasonably be reached by a trainee. // …has to be checked to confirm that it does not contribute to negative training*." In such a case, the full stall is not objectively validated and the expected simulation fidelity is not that high.

- ☐ Check the items below:
  - ☐ Record speeds and angles-of-attack to the tables for low and high altitudes.
  - ☐ Aerodynamics phenomena:
    - ☐ Reduced stability
    - ☐ Roll-off tendency
    - ☐ Secondary stall
  - ☐ Motion cues, such as (see Appendix 1 to CS FSTD(A).300 table 2 item a.1):
    - ☐ buffet build-up as AoA increases
    - ☐ buffet level for approach-to-stall (see Appendix 1 to CS FSTD(A).300 table 2 item d.1.6)
    - ☐ buffet level for full stall

    Angular rates during stall "*For level C or level D devices, special consideration is given to the motion system response during upset prevention and recovery manoeuvres. Notwithstanding the limitations of simulator motion, the operator should place specific emphasis on tuning out objectionable motion system responses, where possible.*"

    See Appendix 1 to CS FSTD(A).300 table 2 item d.1:
    "*if there are known flight conditions where buffet is the first indication of the stall, or where no stall buffet occurs, this characteristic should be included in the model.*"
  - ☐ Stall warning system operation and indications (see CS-FSTD(A) issue 2 'Table of functions and subjective tests' item f.1)
  - ☐ Stall protection system operation and indications (see CS-FSTD(A) issue 2 'Table of functions and subjective tests' item f.1)
  - ☐ Auto-flight control system reaction to stall warning/protection systems (see CS-FSTD(A) issue 2 'Table of functions and subjective tests' item f.1)
  - ☐ FSTD integration (e.g. correct sequence of stall warning, stick shaker, buffet, stall)
  - ☐ Handling characteristics on recovery (e.g. required flight control inputs).

- ☐ Check the IOS tools and flight instruments:
  - ☐ When the aeroplane stalls, the V-n diagram should indicate that the aircraft is at the parabolic line.
    - ☐ Test this both at 1-G and at accelerated stall (e.g. level flight with 45 deg bank angle).
  - ☐ Check that flight instrument indications (e.g. red bar of IAS) are consistent and correct for low and high altitudes.
  - ☐ If the V-n diagram indicates also stall speed for a dynamic stall, check that the indications are correct. Note that a dynamic stall is a case where the wing's angle-of-attack is increased rapidly. This causes a strong vortex that sheds from the leading edge and travels backwards on the wing. The vortex briefly increases the lift. As soon as it passes behind the trailing edge, the lift reduces dramatically (i.e. hysteresis) and the wing is in normal stall.

- ☐ Check the **type specific matters**. Review AFM and statements of compliance to see what type specific phenomena are to be expected. Test their existence subjectively. Describe the expected matters below:

STALL at <u>low altitude</u> FL……….., GW ……….., CG …………. (CLmax increases when CG moves aft)

Configuration	Stall warning IAS	Stall warning AoA	Initial buffet IAS	Initial buffet AoA	Stick shaker IAS	Stick shaker AoA	Stick pusher IAS	Stick pusher AoA	Stall speed	Stall AoA	Reference stall IAS
Clean											
Approach											
Landing											
After ice accumulation											
With bank angle …………°											

STALL at <u>high altitude</u> FL……….., GW ……….., CG ………… (CLmax increases when CG moves aft), Mach…………

Configuration	Stall warning IAS	Stall warning AoA	Initial buffet IAS	Initial buffet AoA	Stick shaker IAS	Stick shaker AoA	Stick pusher IAS	Stick pusher AoA	Stall speed IAS	Stall speed Ma	Stall AoA	Reference stall IAS
Clean												
Approach												
Landing												
After ice accumulation												
With bank angle …………°												

Reference data added to table is based on AFM pages: …………………………….

Note that the stall speeds in AFM for transport category aeroplanes are derived as:

- Trim at 1.3 Vs
- Forward CG
- Deceleration rate on 1 kts/second
- Approximately 1-G flight
- Power off

So note that the indicated airspeed at stall will vary with these factors (see AUPRTA paragraph 6.4.1).

6.7 Full stall (only for the FFS level C and D devices to be qualified for full stall training tasks)

Check approach-to-stall as above. But also similarly full stall as described below.

- ☐ Record speeds and angles-of-attack to the tables for low and high altitudes configurations. Stall angle of attack is defined by AMC10 FSTD(A).300 paragraph (d)(2) as the angle where one or more of the following occur:
    1. No further increase in pitch occurs when pitch control is held full aft for two seconds, leading to an inability to arrest the descent rate
    2. An un-commanded nose-down pitch that cannot be arrested
    3. Buffeting of magnitude and severity that is strong
    4. Activation of stick pusher

- ☐ Check different cases:
    - ☐ Stall entry at wings level (1G). (See Appendix 1 to CS FSTD(A).300 table 1 item s.3.)
    - ☐ Stall entry into turning flight of at least 25° bank angle (i.e. accelerated stall). (See Appendix 1 to CS FSTD(A).300 table 1 item s.3.)
    - ☐ G-break (see CS-FSTD(A) issue 2 'Table of functions and subjective tests' item f.1)
    - ☐ Only for propeller-driven aeroplanes: stall entry into power-on condition. (See Appendix 1 to CS FSTD(A).300 table 1 item s.3.) Note that the stall warnings are based on angle of attack thresholds with engine at idle. At high power settings the enhanced lift generated by the parts of the wings behind the propellers will reduce the angle of attack for the same airspeed. This results in an increased margin above the stall angle of attack. (See AUPRTA paragraph 6.4.2.5.2.)
    - ☐ This can result in stall warning occurring at airspeeds lower than those published in the AFM when the airplane is operating at high power settings.
    - ☐ Stall after ice has accumulated and check that the stall angle of attack is decreased. (See Appendix 1 to CS FSTD(A).300 table 1 item t.1.)

- ☐ Check configurations (see Appendix 1 to CS FSTD(A).300 table 1 item s.3 and 'Table of functions and subjective tests' item f.1):
    - ☐ Take-off
    - ☐ Second segment climb
    - ☐ High altitude cruise near performance limited condition (AMC1 FSTD(A).200 defines it as minimum as FL250 and more precisely as the lowest limit of max certified altitude, thrust-limited altitude and buffet or manoeuvre-limited altitude)
    - ☐ Approach or landing

- ☐ Check phenomena (see AMC9 FSTD(A).300 paragraph (a)(4)):
    - ☐ Degradation of static/dynamic lateral directional stability
    - ☐ Degradation in control response (pitch, roll and yaw)
    - ☐ Uncommanded roll response / roll-off requiring significant control deflection to counter
    - ☐ Apparent randomness or non-repeatability
    - ☐ Changes in pitch stability (Note that pitching up can be observed during stall mainly on aircraft with swept wings.)
    - ☐ CG effects. When CG is moved aft:
        - ☐ CLmax increases.
        - ☐ There is less resistance to lateral "departure".
        - ☐ If there is a pitch-up tendency, it will be greater with an aft CG.
    - ☐ Mach effects. Due to shockwave formation, the stall angle of attack may be clearly lower at high altitude compared to low altitude. Also, there could be a pitch up or pitch down moment due to the shock waves.

- ☐ Check the **type specific matters**. Review AFM and statements of compliance to see what type specific phenomena are to be expected. Test their existence subjectively. Describe the expected matters below:

    - ☐ Check aeroplane type specific phenomena such as :
        - ☐ Presence or absence of pitch break
        - ☐ Deterrent buffet
        - ☐ Other indications of stall associated to the type in question
    - ☐ Check type-specific recognition cues:
        - ☐ Impending aerodynamic stall
        - ☐ First indication of the stall
        - ☐ Stall break sufficiently representative
        - ☐ Recovery sufficiently representative

      Note: 'Representative' in this post-stall context is defined as a level of fidelity that is type-specific of the simulated aeroplane to the extent that the training objectives can be satisfactorily accomplished.

- ☐ Check that stall recovery can be accomplished within FSTD validation envelope (see AMC10 FSTD(A).300 paragraph (d)(2)).

- ☐ For aeroplanes equipped with a stall envelope protection system (see AMC10 FSTD(A).300 paragraph (d)(2)): check stall with protection systems disabled or otherwise degraded (e.g. degraded flight control mode).

- ☐ Sounds. See Appendix 1 to CS FSTD(A).300 table 4 item b.1:
  "*For FSTDs that are to be qualified for full stall training tasks, sounds associated with stall buffet have to be replicated, if significant in the aeroplane.*"

- ☐ Motion cues & buffet
  Buffet should increase in all axis (i.e. increase in Nz, Nx and Ny as applicable for the aeroplane) as angle of attack increases. (See CS-FSTD(A) issue 2 'Table of functions and subjective tests' item n.6.)

Notes on this whole section 6:

Are all the items in section 6 satisfactory?
- ☐ Yes
- ☐ No

Person responsible for assessing this section:

Name:
Date:
Signature: