Flight Simulation Device Qualification Guidance

Windshear – Training and Simulator Requirements

FSTD Guidance Bulletin 03-05

(NOTE: A description of policy concerning windshear approval for simulators not required to comply with the 14 CFR Part 121 requirements follows at the end of this paper under the title: ***"NSP Policy Concerning Advisory Circulars AC120-40B, Appendix 1 and AC120-40C Draft, Appendix 1, Windshear Test Requirements")***

14 CFR Part 121 Regulatory References:

According to 14CFR Part 121.358, Low-Altitude Windshear System Equipment Requirements, the following airplane types must be equipped with "…either an approved airborne windshear warning and flight guidance system, an approved airborne detection and avoidance system, or an approved combination of these systems…"

1. A-300-600;
2. A-310, all series;
3. A-320, all series;
4. B-737-300, -400, and -500 series;
5. B-747-400
6. B-757, all series;
7. B-767, all series;
8. F-100, all series;
9. MD-11, all series;
10. MD-80 series equipped with an EFIS and Honeywell-970 digital flight guidance computer.
11. Any airplane manufactured after January 2, 1991.

This section goes on to say that "…all other turbine-powered airplanes…" (Not listed above or that were manufactured prior to January 2, 1991) "…must be equipped with, as a minimum requirement, an approved airborne windshear warning system. These airplanes may be equipped with an approved airborne windshear detection and avoidance system, or an approved combination of these systems."

This section deals with Part 121 operations ***only***, and defines "turbine-powered airplanes" as including "turbofan-," "turbojet-," "propfan-," and "ultra-high bypass fan-powered" airplanes - but it specifically ***excludes*** "turbopropeller-powered" airplanes.

With the original issuance of the rule, there was the possibility for an authorization to extend the compliance date for this windshear equipment requirement. This extension was tied to the compliance date established for TCAS II retrofit **[**Section 121.358(c)(2)**]**, which, according to the table in Section 121.356(a), would not be later than December 30, 1993.

The above discussion is strictly applicable to Part 121 requirements and does not apply outside of Part 121. However, training conducted under Part 142 (and ***not*** for Part 121 purposes), or training for those operations conducted under Parts 91, 125, or 135, ***may*** include windshear training provided the simulator has been evaluated, found satisfactory, and recommended for such use.

Training Program Requirements:

According to 14CFR Part 121.409(d), "…each certificate holder required to comply with Section 121.358, … must use an approved simulator for each airplane type in each of its pilot training courses that provides training in at least the procedures and maneuvers set forth in the certificate holder's approved low-altitude windshear flight training program."

The recommended training program, contained in the Windshear Training Aid, published by the FAA in February 1987, contains an "Example Windshear Training Program." Contained within this example, is a "Simulator Training Program" section. This section sets out Basic Exercises and Optional Exercises, as to when and where the training crew should encounter a windshear. These exercises are described below:

Basic Exercises:

1.	Takeoff - After Liftoff	During Initial Climb (5 examples given) or During Rotation***** (4 examples given)
2.	Takeoff - On Runway	Prior to V_R (3 examples given)
3.	Approach	During ILS Approach (4 examples given)

*****Airplane lifts off as shear is recognized.

Optional Exercises:

1.	Takeoff (Complex)	Demonstrates real-world application of windshear techniques. (1 example given)
2.	Approach (Complex)	Demonstrates real-world application of windshear techniques. (1 example given)
3.	Stick Shaker Practice	Demonstrates basic airplane response near stall during windshear encounter and recovery. (4 examples given - 2 takeoff, 2 landing)
4.	Increase V_R Speed	Demonstrates correct use of increased rotation speed precautionary technique. (1 example given)

A reminder – these exercises are ***"suggested,"*** and are not required. The training program content will be as submitted by the operator and approved by the Training Program Approval Authority (TPAA). The TPAA is the Principal Operations Inspector (POI), Training Center Program Manager (TCPM), and/or the assigned operations inspector at a Flight Standards District Office (FSDO), as appropriate, who exercises authority on behalf of the Administrator in approving the airplane flight-training program in which the simulator will be used.

Qualification of Simulators Used for Windshear Training Under 14 CFR Part 121:

The basic requirements for a simulator to be satisfactorily evaluated and qualified for windshear training are set out in Appendix 5 of the current guidance for Airplane Simulator Qualification, Advisory Circular (AC) 120-40B.

In this appendix, the requirements for the "windshear models" used must "…provide cues necessary for recognition of the onset of a windshear phenomena and potential performance degradation that would require a pilot to initiate recovery procedures." The degradation "cues" should include one or more of the following:

1. Rapid airspeed change of at least ±15 knots.
2. Stagnation of airspeed during the takeoff roll.
3. Rapid vertical speed change of at least ±500 feet per minute.
4. Rapid pitch change of at least ±5 degrees.

Further, these "windshear models" must be adjustable in intensity (or other parameter to achieve the desired effect) so that when encountered, either of the following results may be achieved (at the option of instructor):

1. Airplane performance permits the pilot to maintain a satisfactory flightpath.
2. Airplane performance does not permit the pilot to maintain a satisfactory flightpath (i.e., the airplane will crash).

Lastly, it is recommended that some default moderate level of turbulence be incorporated into the windshear training scenario.

Objective Evaluation: There are four (4) objective tests that are conducted as a part of the simulator evaluation for windshear training recommendation. The sponsor must submit two (2) of the "windshear models" available in the simulator (one takeoff and one approach). The simulator is flown through calm air (to observe/record performance without the presence of windshear) and then through the selected survivable windshear (to observe/record performance with the presence of windshear) for both the takeoff and the approach case. The results of these tests will be compared to the results of these same tests conducted initially and reviewed/accepted by the NSPM engineering staff.

As part of the Objective Tests, the current requirement is to electronically record and plot the time histories of the following parameters:

1. Indicated or calibrated airspeed.
2. Indicated vertical speed.
3. Pitch attitude.
4. Indicated or radio altitudes.
5. Angle of attack.
6. Elevator position.
7. Engine data (thrust, N_1, or throttle position).
8. Wind magnitudes (simple windshear model assumed – more complex models may require lateral, vertical, and longitudinal plots).

These QTG windshear models should be made available for use in training and clearly identified as such on the IOS.

Subjective Evaluation: A functional evaluation of the simulator's performance in a windshear will be conducted. In this evaluation the simulator will be flown in at least

two (2) "windshear scenarios." One scenario will include parameters that enable the pilot to maintain a satisfactory flightpath and one scenario will include parameters that do not enable the pilot to maintain a satisfactory flightpath (i.e., the simulator will crash). Also, the functional test may include the examination of other scenarios at the discretion of simulator evaluation specialist conducting the evaluation. The scenarios used for this functional evaluation will be selected from the basic exercises or the optional exercises recommended in the Windshear Training Aid, if available, or from those scenarios approved and available to the instructors in the simulator for windshear flight training. It may be that only the two scenarios used for objective testing are available for flight training and, consequently, available for functional testing. If this is the case, the simulator evaluator will notify the TPAA of this limited capability as part of the NSPM response and recommendation to the TPAA. In any event, windshear scenarios available on the IOS should be described in adequate detail to identify the specifics of the windshear encounter (i.e. flight regime, w/s trigger point, wind model detail, etc.)

Windshear Equipment: The equipment installed in the simulator relating to windshear warning and flight guidance or detection and avoidance, must operate and function the same or equivalently to the system(s) installed in the airplane for this purpose. This equipment must provide for the same alerting or advisory notification to the flight crew when the simulator is subjected to any environmental conditions that would have provided alerting or advisory notifications to the flight crew in regular operations in flight. The simulator must operate equivalently to the airplane in any circumstance approaching that of a windshear (i.e., rapid airspeed change of at least ±15 knots; stagnation of airspeed during the takeoff roll; rapid vertical speed change of at least ±500 feet per minute; or rapid pitch change of at least ±5 degrees) and not only when specific environmental models are used, or when specific aircraft configurations are selected, or when specific geographic models (including visual models) are selected. In the report to the TPAA, the simulator evaluator will state that the simulator performs correctly only when these circumstances are found to exist. Otherwise, this report will likely contain recommendations for limitations on windshear training and may, if circumstances warrant, conclude that the evaluation is unsatisfactory, resulting in windshear training ***not*** being authorized.

NSP Policy Concerning Advisory Circulars AC120-40B Appendix 1 and AC 120-40C Draft, 6 – Windshear Test Requirements:

Background: Advisory Circular (AC) AC120-40B and Advisory Circular 120-40C Draft each contain an "Appendix 1" section that lists general simulator standards required for each level of simulator qualified under the applicable AC.

In each referenced AC, Appendix 1, Section 2, Item O, describes the requirements associated with windshear models. These windshear models are required to be a part of each simulator qualified at Level C or Level D. The Appendix 1 "COMMENTS" column associated with the windshear model description for each AC states "Tests required".

Policy: For simulators not required to comply with AC 120-40B, Appendix 5, or AC 120-40C Draft, Appendix 6 (i.e., simulators that are not used to satisfy the training requirements of a 14 CFR Part 121 low-altitude windshear flight training program) NSP policy interprets the windshear tests required by Appendix 1 of each AC to be subjective demonstrations only. If these subjective demonstrations are satisfactory, the simulator will be considered to be in compliance with the windshear test requirements of Appendix 1 of the applicable AC

Objective windshear test cases are not required to be included in the QTG/ATG for these simulators. Although objective test cases are not required, the QTG/ATG for all Level C or Level D simulators qualified under AC 120-40B or AC 120-40C Draft must include information describing the wind model implemented in the simulator windshear demonstrations. The QTG/ATG should reference the "FAA Windshear Training Aid" if it is the source of the wind model used or present airplane related data on whatever alternate wind modeling method was implemented. The required QTG/ATG description of wind modeling should be in the form of a statement of compliance.

The FAA Windshear Training Aid may be found at:

http://www.ntis.gov