



Federal Aviation Administration

Memorandum

Date: March 30, 2009

To: See Distribution

From: Manager, Transport Airplane Directorate, Aircraft Certification Service, ANM-100

Subject: Policy Statement on the Certification of Flight Management Systems (FMS) that Include Takeoff or Approach Reference-Speed Calculations

Memo No.: ANM-111-09-006

Summary

This policy memorandum establishes Federal Aviation Administration (FAA) Transport Airplane Directorate policy for the airworthiness approval of flight-management systems (FMS) that include takeoff reference-speed or landing-approach reference-speed calculations.

Definition of Key Terms

In this policy statement, the formatting (*italics*, plain text, or [square brackets]) and terms used (“must,” “should,” or “recommend”) have specific meaning, explained in Attachment 1.

Current Regulatory and Advisory Material

The regulations applicable to installation and approval of an FMS with a vertical navigation function (VNAV) are 14 CFR 25.1301 and 25.1309. FMS policy is discussed in Advisory Circular (AC) 25-15, “Approval of Flight Management Systems in Transport Category Airplanes.”

Relevant Past Practice

AC 25-15 addresses flight management systems that have performance management functions. AC 25-15 provides an acceptable means of compliance for the computation and display of takeoff reference speeds and landing approach reference speeds. AC 25-15 provides guidance for takeoff mode and landing approach mode performance parameters to meet the integrity criteria for primary means, regardless of how such computed data is proposed to be used.

This policy is in response to two accidents related to erroneous gross-weight data entries, by the flight crew, into FMS computers via the multi-function control and display unit. This policy also addresses NTSB recommendations A-05-03 through A-05-07 issued on March 8, 2005.

Policy

This policy memorandum applies to flight management systems that include takeoff reference speed or landing approach reference speed calculations. AC 25-15 provides an acceptable means of compliance when augmented by the following guidelines:

1. Performance Management Integrity

AC 25-15, paragraph 5.f(10), indicates that the computation and display of airplane performance parameters (such as takeoff and approach reference speeds), when certified as primary means, do not require the flight crew to verify the validity of the displayed information with the airplane flight manual information. AC 25-15, paragraph 5.f(10)(i), states that flightcrew confirmation is required of “all information that would be necessary to manually determine the same takeoff and landing performance data from the approved AFM performance charts prior to utilization by the FMS.” The pilot often enters these parameters from a load sheet, or these parameter values are communicated from the flight-dispatch office and transmitted through datalink. Because these types of data entry are susceptible to error, as received through datalink and entered into FMS, procedural risk-reduction strategies should be used.

As an example, Appendix A of RTCA/DO-296, “Safety Requirements for Aeronautical Operational Control (AOC) Datalink Messages,”¹ provides risk-reduction strategies that should be used when transmitting aircraft weight data via datalink. Similar strategies should be developed to mitigate effects of incorrect pilot entries of data used in computing and displaying takeoff and approach reference speeds. The effectiveness of such risk-reduction strategies should be verified.

2. Method of Entering Airplane Gross Weight

The FMS should not allow the flight crew to manually enter the airplane gross weight. Instead, the FMS should:

- Calculate airplane gross weight from valid zero fuel weight and fuel-weight entries (or other similar logic), or
- Accept airplane gross weight entry through automated means, such as datalink or onboard weight and balance systems.

Applicants who have implemented datalink capabilities for transmitting weight and balance data should use the risk reduction strategies that appear in Appendix A of RTCA/DO-296, “Safety Requirements for Aeronautical Operational Control (AOC) Datalink Messages.” Operators using datalink for direct entry to the FMS should implement formats, performance calculation methods, and dispatch procedures to ensure valid data is transmitted to the airplane.

¹ RTCA/DO-296 can be found at www.RTCA.org

An aircraft onboard weight and balance system, if used, could interface with the FMS and transmit the measured airplane weights directly into the FMS. AC 20-161, “Aircraft Onboard Weight and Balance Systems,” provides an acceptable means of compliance for certification and operational approval of onboard weight and balance systems.

3. Weight Entries and Calculation below Zero Fuel Weight (ZFW)/Operating Empty Weight (OEW)

The FMS should contain minimum ZFW or OEW values for the airplane model on which the FMS is installed.

Takeoff Weight

The FMS should not allow entries into the FMS that result in a takeoff gross weight less than the ZFW or OEW. If such an invalid entry should occur, the FMS should draw flightcrew attention to the error in a manner consistent with other error alerts on the airplane, per 14 CFR 25.1322.

Landing Weight

The FMS should:

- Contain minimum ZFW or OEW values for the airplane model on which the FMS is installed.
- Not allow entries that result in a landing weight less than ZFW or OEW, or
- If the predicted landing weight is below the ZFW or OEW, the FMS should draw flightcrew attention to the error in a manner consistent with other error alerts on the airplane.

4. Data Entry Error Checking

The FMS should include error detection that annunciates the condition to the flight crew when a takeoff speed is calculated or changed to a value that may affect the airplane’s ability to take off safely. This error detection should consist of at least the following:

- If any performance parameter is changed that would affect takeoff performance, the FMS should inform the flight crew in a way that is consistent with other such error alerts given by the airplane or FMS, per § 25.1322. Entries or changes to any parameter that would affect previously entered takeoff speeds should be annunciates to the flight crew.
- Following an event or pilot entry that results in re-computation or re-entry of the takeoff speeds, the FMS should compare the previous and next values and alert the flight crew if there is a difference that exceeds a preset limit. This alert could be an “invalid entry” (or “verify entry”) message or other annunciation consistent with the airplane’s alerting scheme. The preset limit should be established in a way that avoids nuisance alerts.

- The FMS should implement a takeoff-speed check to verify that rotation speed (V_R) is never less than takeoff decision speed (V_1), and takeoff safety speed (V_2) is always greater than or equal to rotation speed (V_R). One logic option could be $V_1 \leq V_R \leq V_2$.

[The FAA recommends that the FMS incorporate error detection based on typical weight entries. Should the takeoff speeds not be representative of typical performance, then an annunciation should be presented to the flight crew. For example, given a valid gross weight, flap setting, etc., the FMS could compare the takeoff-speed entries with a representative range, and annunciate to the flight crew any entry exceeding that representative range. Representative ranges for typical weights could be tightened if the FMS allowed for entry of passenger count with associated baggage allowance.]

5. Operational Limitations

Include in the airplane flight manual, or airplane flight-manual supplement, system-operating procedures and any limitations affecting operations to safeguard against the safety issues identified in this policy memo.

Effect of Policy

The general policy stated in this document does not constitute a new regulation. The FAA individual who implements policy should follow this policy when it is applicable to a specific project. When a proposed method of compliance is outside this established policy, that individual must coordinate it with the policy-issuing office using an issue paper. Similarly, if the implementing office becomes aware of reasons that an applicant's proposal should not be approved, the office must coordinate its response with the policy-issuing office.

Applicants should expect that certificating officials will consider this information when making findings of compliance relevant to new-certificate actions. In addition, as with all advisory material, this statement of policy identifies one means, but not the only means, of compliance.

Implementation

This policy discusses compliance methods that should be applied to type certificate, amended type certificate, supplemental type certificate, and amended supplemental type certificate programs. The compliance methods apply to those programs with an application date on or after the effective date of the final policy. If the date of application precedes the effective date of the final policy, and the methods of compliance have already been coordinated with and approved by the FAA or its designee, the applicant may choose to follow either the previously acceptable methods of compliance or the guidance contained in this policy.

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Attachment: Definition of Key Terms

Distribution List:

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Definition of Key Terms

Table A-1 defines the use of key terms in this policy statement. The table describes the intended functional impact, and the formatting used to highlight these items.

- The term “must” refers to a regulatory requirement that is mandatory for design approval. Text communicating a requirement is in *italics*.
- The term “should” refers to instructions for a particular method of compliance. If an applicant wants to deviate from these instructions, he has to coordinate the alternate method of compliance with the Transport Standards Staff using an issue paper. There is no special text formatting used for methods of compliance.
- The term “recommend” refers to a recommended practice that is optional. Text communicating a recommendation is in [] brackets.

Table A-1 Definition of Key Terms

	Regulatory Requirements	Acceptable Methods of Compliance	Recommendations
Language	Must	Should	Recommend
Format	<i>Italics</i>	Regular text (No special formatting)	[Square brackets]
Functional Impact	No Design Approval if not met	Alternative has to be approved by issue paper.	None, because it is optional