

Special Condition on Flaps-Up Vertical Modal-Suppression System

Applicable to Boeing 787-10

Introductory note:

The following Special Condition has been classified as an important Special Condition and as such shall be subject to public consultation, in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) of which states:

"2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency."

Statement of Issue

The Model 787-10 airplane will incorporate the following novel or unusual design feature:

- A flaps-up vertical modal suppression system (F0VMS).

This will be the first time an active modal-suppression system will be used for meeting the requirement CS 25.629 compliance.

EASA considers the use of this new active modal-suppression system for flutter compliance to be novel or unusual when compared to the technology envisioned in the current airworthiness standards. Consequently, special conditions are required in consideration of the effects of this new system on the aeroelastic stability of the aeroplane, both in the normal and failed state, to maintain the level of safety intended by CS 25.629.

Special Condition D-03-10 - Flaps-Up Vertical Modal-Suppression System

Applicable to Boeing 787-10

The following Special Condition proposal will be part of the type certification basis for Boeing Model 787-10 airplanes.

This Special Condition address the aeroelastic stability of the 787-10 airplane with the F0VMS system as an integral part of the PFCS Normal mode:

Analytical Flutter-Clearance Requirements

1. The aeroplane in the PFCS Normal mode (which includes F0VMS) must meet the nominal (no failures) flutter and aeroelastic stability requirements of CS 25.629(b)(1), and the damping-margin criteria of AC 25.629-1B. Figure 1 below illustrates the Damping versus Airspeed plot.

The aeroservoelastic analysis must take into account the effect of the following items:

- Significant structural and aerodynamic nonlinearities.
- Significant F0VMS non-linearities, including control-surface rate and

displacement saturation, and blowdown.

- The range of design maneuver load factors.
- Control surface freeplay.
- Any other items that may affect the performance of the F0VMS system in maintaining adequate modal damping margins.

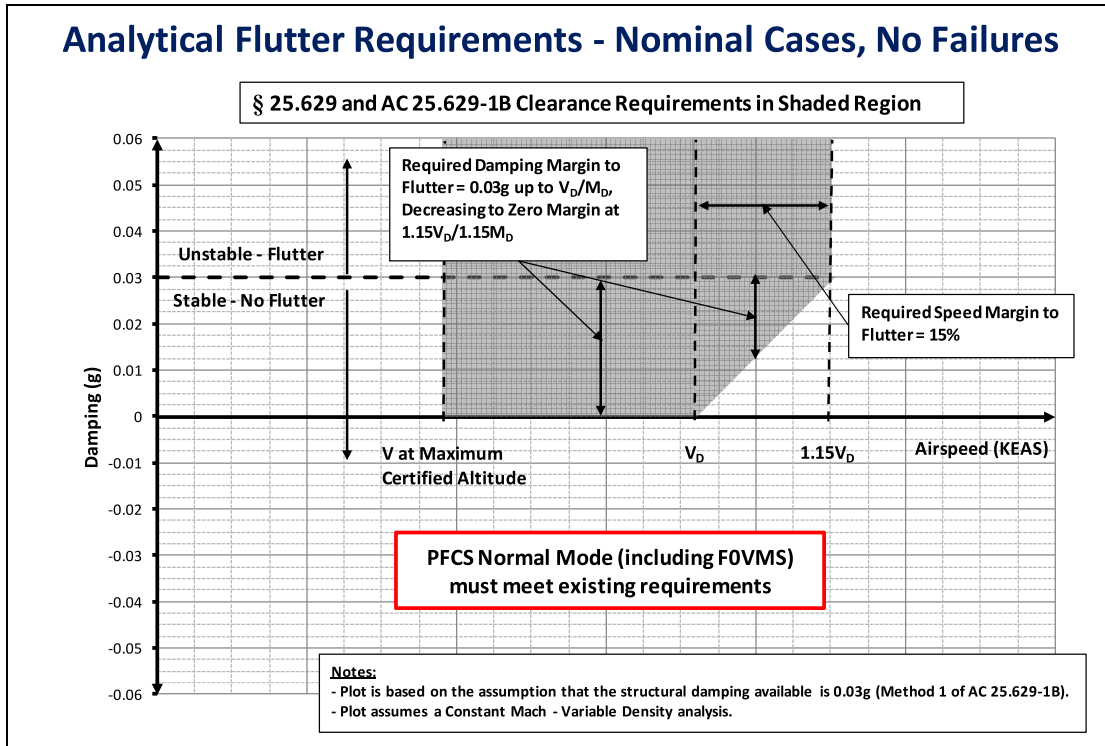


Figure 1: Damping vs. Airspeed; PFCS Normal mode, F0VMS system operative

- The aeroplane in the PFCS Normal mode, but with the F0VMS system inoperative¹, must exhibit a damping margin to flutter of 0.015g within the V_D/M_D envelope, linearly decreasing (in KEAS) to zero damping margin to flutter at 1.15 V_D / 1.15 M_D , limited to Mach 1.0. That is, any mode to be suppressed by the suppression system should not cross the $g=0.015$ line below V_D , or the $g=0.03$ line below 1.15 V_D , assuming the use of analysis Method 1 of AC 25.629-1B, Section 7.1.3.3. Figure 2, below, illustrates the Damping versus Airspeed plot.

¹ or in any potential condition between operative and inoperative

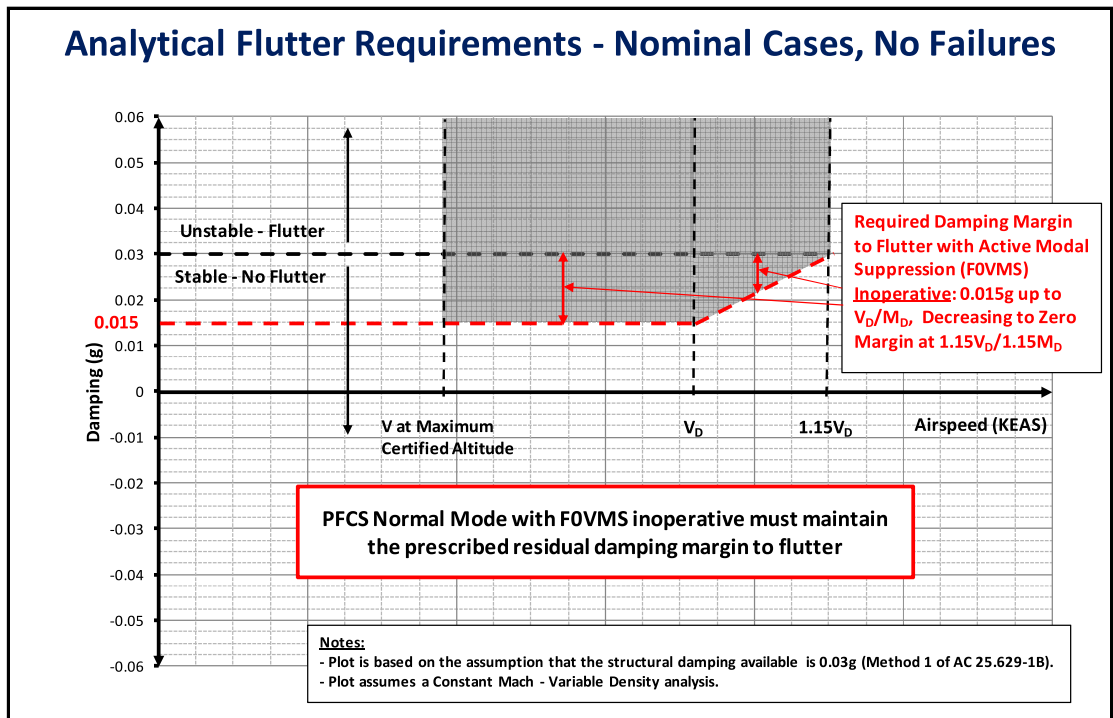


Figure 2: Damping vs. Airspeed; PFCS Normal mode, F0VMS system inoperative

3. The aeroplane in the PFCS Normal mode (which includes F0VMS) must meet the fail-safe flutter and aeroelastic stability requirements of CS 25.629(b)(2), CS 25.302 and Appendix K, and (mutatis mutandis) the damping-margin criteria of AC 25.629-1B, Section 7.1.3.5.
4. The aeroplane in the PFCS Secondary and Direct modes must meet the fail-safe flutter and aeroelastic-stability requirements of CS 25.629(b)(2), CS 25.302 and Appendix K, and (mutatis mutandis) the damping-margin criteria of AC 25.629-1B, Section 7.1.3.5.
5. Dispatch with the F0VMS system inoperative is not allowed.