U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: DESIGN DIVE SPEED
Date: 10/20/97
Initiated by: ANM-110
AC No: 25.335-1
Change:

1. PURPOSE. This advisory circular (AC) sets forth an acceptable means, but not the only means, of demonstrating compliance with the provisions of part 25 of the Federal Aviation Regulations (FAR) related to the minimum speed margin between design cruise speed and design dive speed for transport category airplanes. Like all AC's, it is not regulatory but is to provide guidance for applicants in demonstrating compliance with the objective safety standards set forth in the rule.

2. RELATED FAR SECTIONS. Part 25, Section 25.335 "Design airspeeds."

3. BACKGROUND. Section 25.335(b) requires the design dive speed, V_D, of the airplane to be established so that the design cruise speed is no greater than 0.8 times the design dive speed, or that it be based on an upset criterion initiated at the design cruise speed, V_C. At altitudes where the cruise speed is limited by compressibility effects, § 25.335(b)(2) requires the margin to be not less than 0.05 Mach. Furthermore, at any altitude, the margin must be great enough to provide for atmospheric variations (such as horizontal gusts and the penetration of jet streams), instrument errors, and production variations. This AC provides a rational method for considering the atmospheric variations.

4. DESIGN DIVE SPEED.

a. In the absence of evidence supporting alternative criteria, compliance with § 25.335(b)(2) may be shown by providing a margin between V_C/M_C and V_D/M_D sufficient to provide for the following atmospheric conditions:

(1) Encounter with a Horizontal Gust. The effect of encounters with a substantially head-on gust, assumed to act at the most adverse angle between 30° above and 30° below the flight path, should be considered. The gust velocity should be 50 fps in equivalent airspeed (EAS) at altitudes up to 20,000 feet. At altitudes above 20,000 feet the gust velocity may be reduced linearly from 50 fps in EAS at 20,000 feet to 25 fps EAS at 50,000 feet, above which the gust velocity is considered to be constant. The gust velocity should be assumed to build up in not more than 2 seconds and last for 30 seconds.

(2) Entry into Jetstreams or Regions of High Windshear.

(i) Conditions of horizontal and vertical windshear should be investigated taking into account the windshear data of this paragraph which are world-wide extreme values.

(ii) With the airplane at V_C/M_C within normal rates of climb and descent, the most extreme condition of windshear that it might encounter, according to available meteorological data, can be expressed as follows:

(A) *Horizontal Windshear.* The jet stream is assumed to consist of a linear shear of 3.6 KTAS/NM over a distance of 25 NM or of 2.52 KTAS/NM over a distance of 50 NM or of 1.8 KTAS/NM over a distance of 100 NM whichever is most severe.

(B) *Vertical Windshear.* The jet stream is assumed to have the following characteristics: As a conservative approach it is assumed that these values apply at all altitudes.

TABLE 1

1	A shear of 104 KTAS/1000 feet over a height band of 1000 feet
2	A shear of 56.5 KTAS/1000 feet over a height band of 3000 feet
3.	A shear of 38.6 KTAS/1000 feet over a height band of 5000 feet
4.	A shear of 29.7 KTAS/1000 feet over a height band of 7000 feet

(iii) The entry of the airplane into horizontal and vertical windshears should be treated as separate cases. Because the penetration of these large scale phenomena is fairly slow, recovery action by the pilot is usually possible. In the case of manual flight (i.e., when flight is being controlled by inputs made by the pilot), the airplane is assumed to maintain constant attitude until at least 3 seconds after the operation of the overspeed warning device, at which time recovery action may be started by using the primary aerodynamic controls and thrust at a normal acceleration of 1.5g, or the maximum available, whichever is lower.

b. At altitudes where speed is limited by Mach number, a speed margin of .07 Mach between M_C and M_D is considered sufficient without further investigation.

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