U.S. Department
of Transportation
Federal Aviation Administration

Advisory Circular

Subject: DESIGN DIVE SPEED **Date:** 9/29/00 **AC No.** 25.335-1A
Initiated by: ANM-110

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

2. CANCELATION. Advisory Circular 25.335-1, Design Dive Speed, dated 10/20/97, is canceled.

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

4. 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.

5. DESIGN DIVE SPEED MARGIN DUE TO ATMOSPHERIC VARIATIONS.

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 degrees above and 30 degrees 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 in 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) Horizontal windshear is the rate of change of horizontal wind speed with horizontal distance. Encounters with horizontal windshear change the airplane apparent head wind in level flight as the airplane traverses into regions of changing wind speed. The horizontal windshear region is assumed to have no significant vertical gradient of wind speed.

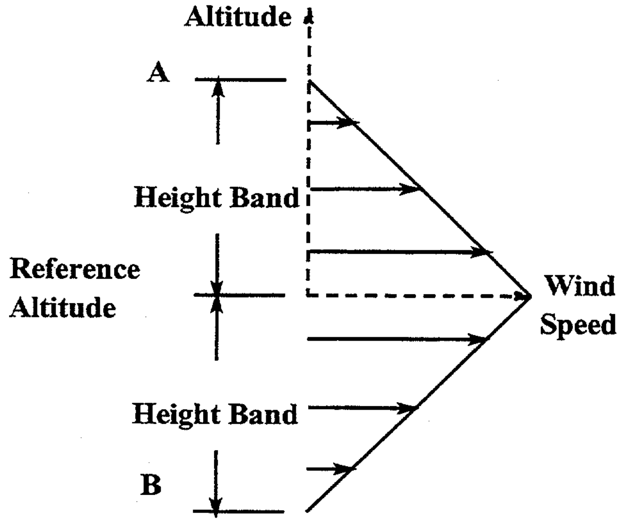
(iii) Vertical windshear is the rate of change of horizontal wind speed with altitude. Encounters with windshear change the airplane apparent head wind as the airplane climbs or descends into regions of changing wind speed. The vertical windshear region changes slowly so that temporal or spatial changes in the vertical windshear gradient are assumed to have no significant affect on an airplane in level flight.

(iv) 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 windshear region is assumed to have the most severe of the following characteristics and design values for windshear intensity and height band. As shown in Figure 1, the total vertical thickness of the windshear region is twice the height band so that the windshear intensity specified in Table 1 applies to a vertical distance equal to the height band above and below the reference altitude. The variation of horizontal wind speed with altitude in the windshear region is linear through the height band from zero at the edge of the region to a strength at the reference altitude determined by the windshear intensity multiplied by the height band. Windshear intensity varies linearly between the reference altitudes in Table 1.

Figure 1 - Windshear Region



Note:
The analysis should be conducted by separately

descending from point "A"
and
climbing from point "B"

into initially increasing headwind.

Table 1 - Vertical Windshear Intensity Characteristics

	Height Band - Ft.			
	1000	**3000**	**5000**	**7000**
Reference Altitude - Ft.	**Vertical Windshear** **Units: ft./sec. per foot of height (KTAS per 1000 feet of height)**			
0	0.095 (56.3)	0.05 (29.6)	0.035 (20.7)	0.03 (17.8)
40,000	0.145 (85.9)	0.075 (44.4)	0.055 (32.6)	0.04 (23.7)
45,000	0.265 (157.0)	0.135 (80.0)	0.10 (59.2)	0.075 (44.4)
Above 45,000	0.265 (157.0)	0.135 (80.0)	0.10 (59.2)	0.075 (44.4)
Windshear intensity varies linearly between specified altitudes.				

(v) The entry of the airplane into horizontal and vertical windshear 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.

DORENDA D. BAKER
Acting Manager, Transport Airplane Directorate
Aircraft Certification Service, ANM-100

U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591