

(b) *Maneuvering balanced conditions.* Assuming the airplane to be in equilibrium with zero pitching acceleration, the maneuvering conditions A through I on the maneuvering envelope in § 25.333(b) must be investigated.

(c) *Pitch maneuver conditions.* The conditions specified in paragraphs (c)(1) and (2) of this section must be investigated. The movement of the pitch control surfaces may be adjusted to take into account limitations imposed by the maximum pilot effort specified by § 25.397(b), control system stops and any indirect effect imposed by limitations in the output side of the control system (for example, stalling torque or maximum rate obtainable by a power control system.)

(1) *Maximum pitch control displacement at  $V_A$ .* The airplane is assumed to be flying in steady level flight (point A<sub>1</sub>, § 25.333(b)) and the cockpit pitch control is suddenly moved to obtain extreme nose up pitching acceleration. In defining the tail load, the response of the airplane must be taken into account. Airplane loads that occur subsequent to the time when normal acceleration at the c.g. exceeds the positive limit maneuvering load factor (at point A<sub>2</sub> in § 25.333(b)), or the resulting tailplane normal load reaches its maximum, whichever occurs first, need not be considered.

(2) *Specified control displacement.* A checked maneuver, based on a rational pitching control motion vs. time profile, must be established in which the design limit load factor specified in § 25.337 will not be exceeded. Unless lesser values cannot be exceeded, the airplane response must result in pitching accelerations not less than the following:

(i) A positive pitching acceleration (nose up) is assumed to be reached con-

currently with the airplane load factor of 1.0 (Points A<sub>1</sub> to D<sub>1</sub>, § 25.333(b)). The positive acceleration must be equal to at least

$$\frac{39n}{v} (n - 1.5), \left( \text{Radians/sec.}^2 \right)$$

where—

n is the positive load factor at the speed under consideration, and V is the airplane equivalent speed in knots.

(ii) A negative pitching acceleration (nose down) is assumed to be reached concurrently with the positive maneuvering load factor (points A<sub>2</sub> to D<sub>2</sub>, § 25.333(b)). This negative pitching acceleration must be equal to at least

$$\frac{-26n}{v} (n - 1.5), \left( \text{Radians/sec.}^2 \right)$$

where—

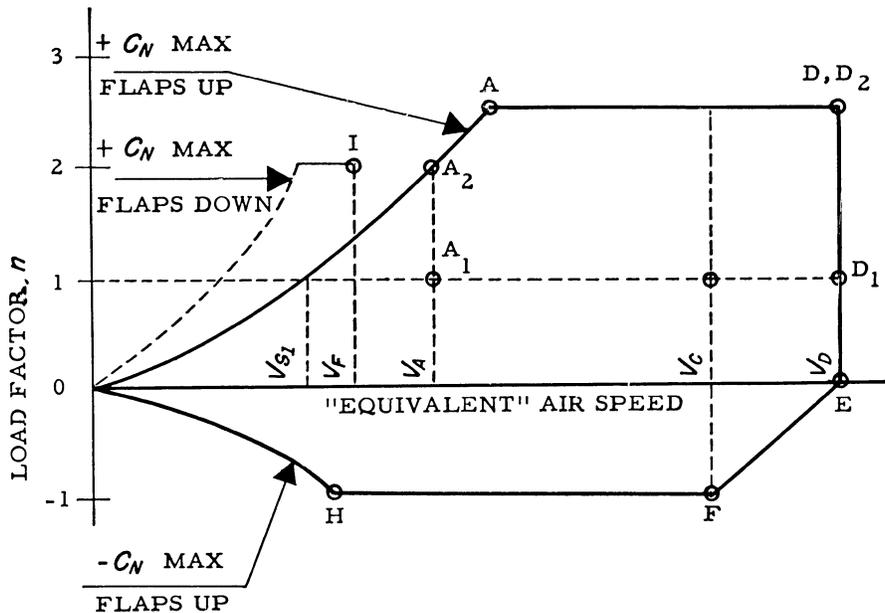
n is the positive load factor at the speed under consideration; and V is the airplane equivalent speed in knots.

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#### § 25.333 Flight maneuvering envelope.

(a) *General.* The strength requirements must be met at each combination of airspeed and load factor on and within the boundaries of the representative maneuvering envelope (*V-n* diagram) of paragraph (b) of this section. This envelope must also be used in determining the airplane structural operating limitations as specified in § 25.1501.

(b) *Maneuvering envelope.*



[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-86, 61 FR 5220, Feb. 9, 1996]

**§ 25.335 Design airspeeds.**

The selected design airspeeds are equivalent airspeeds (EAS). Estimated values of  $V_{S0}$  and  $V_{S1}$  must be conservative.

(a) *Design cruising speed,  $V_C$ .* For  $V_C$ , the following apply:

(1) The minimum value of  $V_C$  must be sufficiently greater than  $V_B$  to provide for inadvertent speed increases likely to occur as a result of severe atmospheric turbulence.

(2) Except as provided in § 25.335(d)(2),  $V_C$  may not be less than  $V_B + 1.32 U_{REF}$  (with  $U_{REF}$  as specified in § 25.341(a)(5)(1)). However  $V_C$  need not exceed the maximum speed in level flight at maximum continuous power for the corresponding altitude.

(3) At altitudes where  $V_D$  is limited by Mach number,  $V_C$  may be limited to a selected Mach number.

(b) *Design dive speed,  $V_D$ .*  $V_D$  must be selected so that  $V_C/M_C$  is not greater than  $0.8 V_D/M_D$ , or so that the minimum speed margin between  $V_C/M_C$  and  $V_D/M_D$  is the greater of the following values:

(1) From an initial condition of stabilized flight at  $V_C/M_C$ , the airplane is upset, flown for 20 seconds along a flight path  $7.5^\circ$  below the initial path, and then pulled up at a load factor of 1.5g (0.5g acceleration increment). The speed increase occurring in this maneuver may be calculated if reliable or conservative aerodynamic data is used. Power as specified in § 25.175(b)(1)(iv) is assumed until the pullup is initiated, at which time power reduction and the use of pilot controlled drag devices may be assumed;

(2) The minimum speed margin must be enough to provide for atmospheric variations (such as horizontal gusts, and penetration of jet streams and cold fronts) and for instrument errors and airframe production variations. These factors may be considered on a probability basis. The margin at altitude where  $M_C$  is limited by compressibility effects must not less than 0.07M unless a lower margin is determined using a rational analysis that includes the effects of any automatic systems. In any