

### § 23.333

(c) Mutual influence of the aerodynamic surfaces must be taken into account when determining flight loads.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964; 30 FR 258, Jan. 9, 1965, as amended by Amdt. 23-42, 56 FR 352, Jan. 3, 1991]

### § 23.333 Flight envelope.

(a) *General.* Compliance with the strength requirements of this subpart must be shown at any combination of airspeed and load factor on and within the boundaries of a flight envelope (similar to the one in paragraph (d) of this section) that represents the envelope of the flight loading conditions specified by the maneuvering and gust criteria of paragraphs (b) and (c) of this section respectively.

(b) *Maneuvering envelope.* Except where limited by maximum (static) lift coefficients, the airplane is assumed to be subjected to symmetrical maneuvers resulting in the following limit load factors:

(1) The positive maneuvering load factor specified in § 23.337 at speeds up to  $V_D$ ;

(2) The negative maneuvering load factor specified in § 23.337 at  $V_C$ ; and

(3) Factors varying linearly with speed from the specified value at  $V_C$  to 0.0 at  $V_D$  for the normal and commuter category, and -1.0 at  $V_D$  for the acrobatic and utility categories.

(c) *Gust envelope.* (1) The airplane is assumed to be subjected to symmetrical vertical gusts in level flight. The

### 14 CFR Ch. I (1-1-11 Edition)

resulting limit load factors must correspond to the conditions determined as follows:

(i) Positive (up) and negative (down) gusts of 50 f.p.s. at  $V_C$  must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 50 f.p.s. at 20,000 feet to 25 f.p.s. at 50,000 feet.

(ii) Positive and negative gusts of 25 f.p.s. at  $V_D$  must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 25 f.p.s. at 20,000 feet to 12.5 f.p.s. at 50,000 feet.

(iii) In addition, for commuter category airplanes, positive (up) and negative (down) rough air gusts of 66 f.p.s. at  $V_B$  must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 66 f.p.s. at 20,000 feet to 38 f.p.s. at 50,000 feet.

(2) The following assumptions must be made:

(i) The shape of the gust is—

$$U = \frac{U_{de}}{2} \left( 1 - \cos \frac{2\pi s}{25C} \right)$$

Where—

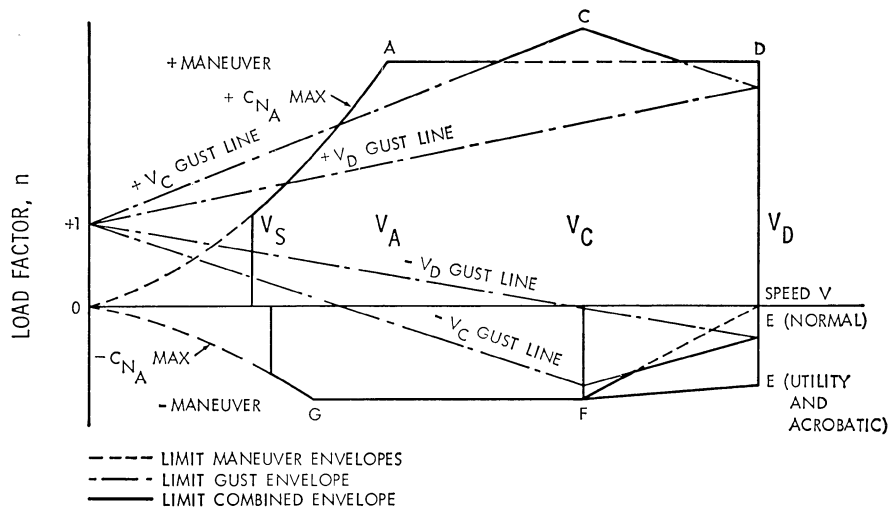
$s$ =Distance penetrated into gust (ft.);

$C$ =Mean geometric chord of wing (ft.); and

$U_{de}$ =Derived gust velocity referred to in subparagraph (1) of this section.

(ii) Gust load factors vary linearly with speed between  $V_C$  and  $V_D$ .

(d) *Flight envelope.*



[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-7, 34 FR 13087, Aug. 13, 1969; Amdt. 23-34, 52 FR 1829, Jan. 15, 1987]

### § 23.335 Design airspeeds.

Except as provided in paragraph (a)(4) of this section, the selected design airspeeds are equivalent airspeeds (EAS).

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

(1) Where  $W/S$ =wing loading at the design maximum takeoff weight,  $V_c$  (in knots) may not be less than—

(i)  $33 \sqrt{W/S}$  (for normal, utility, and commuter category airplanes);

(ii)  $36 \sqrt{W/S}$  (for acrobatic category airplanes).

(2) For values of  $W/S$  more than 20, the multiplying factors may be decreased linearly with  $W/S$  to a value of 28.6 where  $W/S=100$ .

(3)  $V_C$  need not be more than  $0.9 V_H$  at sea level.

(4) At altitudes where an  $M_D$  is established, a cruising speed  $M_C$  limited by compressibility may be selected.

(b) *Design dive speed  $V_D$ .* For  $V_D$ , the following apply:

(1)  $V_D/M_D$  may not be less than  $1.25 V_C/M_C$ ; and

(2) With  $V_C \min$ , the required minimum design cruising speed,  $V_D$  (in knots) may not be less than—

(i)  $1.40 V_C \min$  (for normal and commuter category airplanes);

(ii)  $1.50 V_C \min$  (for utility category airplanes); and

(iii)  $1.55 V_C \min$  (for acrobatic category airplanes).

(3) For values of  $W/S$  more than 20, the multiplying factors in paragraph (b)(2) of this section may be decreased linearly with  $W/S$  to a value of 1.35 where  $W/S=100$ .

(4) Compliance with paragraphs (b)(1) and (2) of this section need not be shown if  $V_D/M_D$  is selected so that the minimum speed margin between  $V_C/M_C$  and  $V_D/M_D$  is the greater of the following:

(i) The speed increase resulting when, from the initial condition of stabilized flight at  $V_C/M_C$ , the airplane is assumed to be upset, flown for 20 seconds along a flight path  $7.5^\circ$  below the initial path, and then pulled up with a load factor of 1.5 (0.5  $g$  acceleration increment). At least 75 percent maximum continuous power for reciprocating engines, and maximum cruising power for turbines, or, if less, the power required for  $V_C/M_C$  for both kinds of engines, must be assumed until the pullup is initiated, at which point power reduction and pilot-controlled drag devices may be used; and either—