FLIGHT LOADS

§ 23.321 General.

(a) Flight load factors represent the ratio of the aerodynamic force component (acting normal to the assumed longitudinal axis of the airplane) to the weight of the airplane. A positive flight load factor is one in which the aerodynamic force acts upward, with respect to the airplane.

(b) Compliance with the flight load requirements of this subpart must be shown—

(1) At each critical altitude within the range in which the airplane may be expected to operate;

(2) At each weight from the design minimum weight to the design maximum weight; and

(3) For each required altitude and weight, for any practicable distribution of disposable load within the operating limitations specified in §§ 23.1583 through 23.1589.

(c) When significant, the effects of compressibility must be taken into account.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23–45, 58 FR 42160, Aug. 6, 1993]

§ 23.331 Symmetrical flight conditions.

(a) The appropriate balancing horizontal tail load must be accounted for in a rational or conservative manner when determining the wing loads and linear inertia loads corresponding to any of the symmetrical flight conditions specified in §§ 23.333 through 23.341.

(b) The incremental horizontal tail loads due to maneuvering and gusts must be reacted by the angular inertia of the airplane in a rational or conservative manner.

(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 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 VB 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—

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

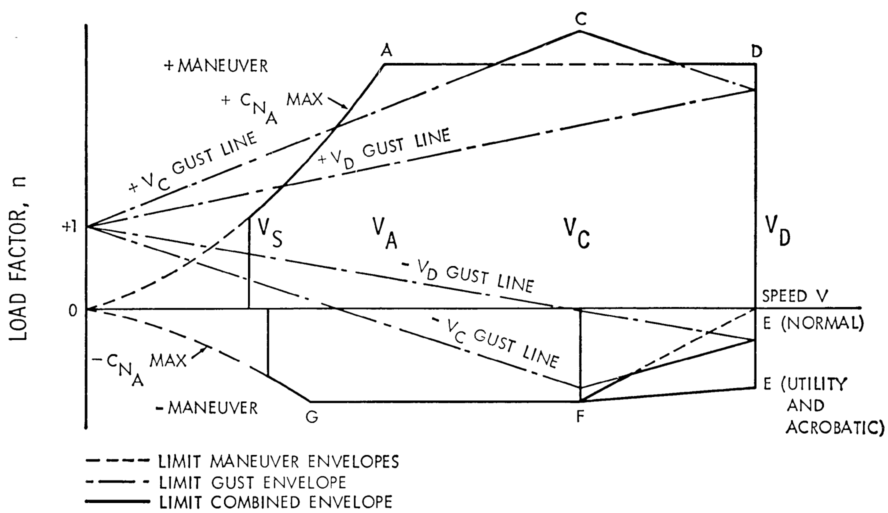
Where—

s=Distance penetrated into gust (ft.);
C=Mean geometric chord of wing (ft.); and

Ude=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 √(W/S) (for normal, utility, and commuter category airplanes);

(ii) 36 √(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° below the initial path, and then pulled up with a load factor of 1.5 (0.5 *g*. acceleration increment). At