

**§ 23.337 Limit maneuvering load factors.**

(a) The positive limit maneuvering load factor *n* may not be less than—

(1)  $2.1 + (24,000 \div (W + 10,000))$  for normal and commuter category airplanes, where *W*=design maximum takeoff weight, except that *n* need not be more than 3.8;

(2) 4.4 for utility category airplanes; or

(3) 6.0 for acrobatic category airplanes.

(b) The negative limit maneuvering load factor may not be less than—

(1) 0.4 times the positive load factor for the normal utility and commuter categories; or

(2) 0.5 times the positive load factor for the acrobatic category.

(c) Maneuvering load factors lower than those specified in this section may be used if the airplane has design features that make it impossible to exceed these values in flight.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-7, 34 FR 13088, Aug. 13, 1969; Amdt. 23-34, 52 FR 1829, Jan. 15, 1987; Amdt. 23-48, 61 FR 5144, Feb. 9, 1996]

**§ 23.341 Gust loads factors.**

(a) Each airplane must be designed to withstand loads on each lifting surface resulting from gusts specified in § 23.333(c).

(b) The gust load for a canard or tandem wing configuration must be computed using a rational analysis, or may be computed in accordance with paragraph (c) of this section, provided that the resulting net loads are shown to be conservative with respect to the gust criteria of § 23.333(c).

(c) In the absence of a more rational analysis, the gust load factors must be computed as follows—

$$n = 1 + \frac{K_g U_{de} V a}{498 (W/S)}$$

Where—

$K_g=0.88\mu_g/5.3+\mu_g$ =gust alleviation factor;

$\mu_g=2(W/S)/\rho Cag$ =airplane mass ratio;

$U_{de}$ =Derived gust velocities referred to in § 23.333(c) (f.p.s.);

$\rho$ =Density of air (slugs/cu.ft.);

$W/S$ =Wing loading (p.s.f.) due to the applicable weight of the airplane in the particular load case.

$W/S$ =Wing loading (p.s.f.);

$C$ =Mean geometric chord (ft.);

$g$ =Acceleration due to gravity (ft./sec.<sup>2</sup>)

$V$ =Airplane equivalent speed (knots); and

$a$ =Slope of the airplane normal force coefficient curve  $C_{NA}$  per radian if the gust loads are applied to the wings and horizontal tail surfaces simultaneously by a rational method. The wing lift curve slope  $C_L$  per radian may be used when the gust load is applied to the wings only and the horizontal tail gust loads are treated as a separate condition.

[Amdt. 23-7, 34 FR 13088, Aug. 13, 1969, as amended by Amdt. 23-42, 56 FR 352, Jan. 3, 1991; Amdt. 23-48, 61 FR 5144, Feb. 9, 1996]

**§ 23.343 Design fuel loads.**

(a) The disposable load combinations must include each fuel load in the range from zero fuel to the selected maximum fuel load.

(b) If fuel is carried in the wings, the maximum allowable weight of the airplane without any fuel in the wing tank(s) must be established as "maximum zero wing fuel weight," if it is less than the maximum weight.

(c) For commuter category airplanes, a structural reserve fuel condition, not exceeding fuel necessary for 45 minutes of operation at maximum continuous power, may be selected. If a structural reserve fuel condition is selected, it must be used as the minimum fuel weight condition for showing compliance with the flight load requirements prescribed in this part and—

(1) The structure must be designed to withstand a condition of zero fuel in the wing at limit loads corresponding to:

(i) Ninety percent of the maneuvering load factors defined in § 23.337, and

(ii) Gust velocities equal to 85 percent of the values prescribed in § 23.333(c).

(2) The fatigue evaluation of the structure must account for any increase in operating stresses resulting from the design condition of paragraph (c)(1) of this section.

(3) The flutter, deformation, and vibration requirements must also be met with zero fuel in the wings.

[Doc. No. 27805, 61 FR 5144, Feb. 9, 1996]