§ 25.337 Limit maneuvering load factors.

(a) Except where limited by maximum (static) lift coefficients, the airplane is assumed to be subjected to symmetrical maneuvers resulting in the limit maneuvering load factors prescribed in this section. Pitching velocities appropriate to the corresponding pull-up and steady turn maneuvers must be taken into account.

(b) The positive limit maneuvering load factor \( n \) for any speed up to \( V_n \) may not be less than 2.1+24,000/(\( W \) +10,000) except that \( n \) may not be less than 2.5 and need not be greater than 3.8—where \( W \) is the design maximum takeoff weight.

(c) The negative limit maneuvering load factor—
§ 25.341 Gust and turbulence loads.

(a) Discrete Gust Design Criteria. The airplane is assumed to be subjected to symmetrical vertical and lateral gusts in level flight. Limit gust loads must be determined in accordance with the provisions:

(1) Loads on each part of the structure must be determined by dynamic analysis. The analysis must take into account unsteady aerodynamic characteristics and all significant structural degrees of freedom including rigid body motions.

(2) The shape of the gust must be:

\[ U = \frac{U_{ds}}{2} \left( 1 - \cos \left( \frac{s \pi}{H} \right) \right) \]

for \( 0 \leq s \leq 2H \)

where—
- \( s \) = distance penetrated into the gust (feet);
- \( U_{ds} \) = the design gust velocity in equivalent airspeed specified in paragraph (a)(4) of this section; and
- \( H \) = the gust gradient which is the distance (feet) parallel to the airplane’s flight path for the gust to reach its peak velocity.

(3) A sufficient number of gust gradient distances in the range 30 feet to 350 feet must be investigated to find the critical response for each load quantity.

(4) The design gust velocity must be:

\[ U_{ds} = U_{ref} \sqrt{F_g \left( \frac{H}{350} \right)^{1.6}} \]

where—
- \( U_{ref} \) = the reference gust velocity in equivalent airspeed defined in paragraph (a)(5) of this section.
- \( F_g \) = the flight profile alleviation factor defined in paragraph (a)(6) of this section.

(5) The following reference gust velocities apply:

(i) At the airplane design speed \( V_C \):

Positive and negative gusts with reference gust velocities of 56.0 ft/sec EAS must be considered at sea level. The reference gust velocity may be reduced linearly from 56.0 ft/sec EAS at sea level to 44.0 ft/sec EAS at 15000 feet. The reference gust velocity may be further reduced linearly from 44.0 ft/sec EAS at 15000 feet to 26.0 ft/sec EAS at 50000 feet.

(ii) At the airplane design speed \( V_D \):

The reference gust velocity must be 0.5 times the value obtained under §25.341(a)(5)(i).

(6) The flight profile alleviation factor, \( F_g \), must be increased linearly from the sea level value to a value of 1.0 at the maximum operating altitude defined in §25.1527. At sea level, the flight profile alleviation factor is determined by the following equation:

\[ F_g = 0.5 \left( F_{gz} + F_{gm} \right) \]

Where:

\[ F_{gz} = 1 - \frac{Z_{mo}}{25000} \]

\[ F_{gm} = \sqrt{\frac{R_2 \tan \left( \frac{\pi R_1}{4} \right)}{R_1 \tan \left( \frac{\pi R_2}{4} \right)}} \]

\[ R_1 = \frac{\text{Maximum Landing Weight}}{\text{Maximum Take-off Weight}} \]

\[ R_2 = \frac{\text{Maximum Zero Fuel Weight}}{\text{Maximum Take-off Weight}} \]

\( Z_{mo} \) = Maximum operating altitude defined in §25.1527.

(b) Continuous Gust Design Criteria. The dynamic response of the airplane to vertical and lateral continuous turbulence must be taken into account. The continuous gust design criteria of appendix G of this part must be used to