Federal Aviation Administration, DOT

§ 23.341

(ii) Mach 0.05 for normal, utility, and acrobatic category airplanes (at altitudes where $M_D$ is established); or
(iii) Mach 0.07 for commuter category airplanes (at altitudes where $M_D$ is established) unless a rational analysis, including the effects of automatic systems, is used to determine a lower margin. If a rational analysis is used, the minimum speed margin must be enough to provide for atmospheric variations (such as horizontal gusts), and the penetration of jet streams or cold fronts), instrument errors, airframe production variations, and must not be less than Mach 0.05.

(c) Design maneuvering speed $V_A$. For $V_A$, the following applies:

(i) $V_A$ may not be less than $VS_{\sqrt{n}}$ where—

(ii) $n$ is the limit maneuvering load factor used in design.

(2) The value of $V_A$ need not exceed the speed determined by the intersection of the line representing the maximum positive lift, $C_{\text{NMAX}}$, and the line representing the rough air gust velocity on the gust $V$-$n$ diagram, or $VS_1\sqrt{n}$, whichever is less, where:

(i) $n$ the positive airplane gust load factor due to gust, at speed $V_C$ (in accordance with §23.341), and at the particular weight under consideration; and

(ii) $VS_1$ is the stalling speed with the flaps retracted at the particular weight under consideration.

(2) $V_B$ need not be greater than $V_C$.

§ 23.337 Limit maneuvering load factors.

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

(1) 2.1+($2,000/(W+10,000)$) for normal and commuter category airplanes, where $W=\text{design maximum takeoff weight}$, 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.

§ 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—

\[
K_n \frac{U_{\text{deg}} V_a}{498 (W/S)}
\]

Where—

\[K_n=0.88\mu /3.3+\mu =\text{gust alleviation factor};\]

\[\mu =2(W/S) \rho C_{\text{ag}} / \text{airplane mass ratio};\]

\[U_{\text{deg}}=\text{Derived gust velocities referred to in §23.333(c) (f.p.s.);}\]

\[\rho =\text{Density of air (slugs/cu.ft.);}\]

\[W/S=\text{Wing loading (p.s.f.) due to the applicable weight of the airplane in the particular load case.}\]

\[C=\text{Mean geometric chord (ft.);}\]

\[a=\text{Slope of the airplane normal force coefficient curve } C_{\text{N}} \text{ per radian if the gust loads are applied to the wings and horizontal tail.}\]
§ 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.

§ 23.345 High lift devices.
(a) If flaps or similar high lift devices are to be used for takeoff, approach or landing, the airplane, with the flaps fully extended at $V_F$, is assumed to be subjected to symmetrical maneuvers and gusts within the range determined by—
(1) Maneuvering, to a positive limit load factor of 2.0; and
(2) Positive and negative gust of 25 feet per second acting normal to the flight path in level flight.
(b) $V_F$ must be assumed to be not less than 1.4 $V_S$ or 1.8 $V_{SF}$, whichever is greater, where—
(1) $V_S$ is the computed stalling speed with flaps retracted at the design weight; and
(2) $V_{SF}$ is the computed stalling speed with flaps fully extended at the design weight.
(c) If an automatic flap load limiting device is used, the airplane may be designed for the critical combinations of airspeed and flap position allowed by that device.
(d) The flaps, their operating mechanism, and their supporting structures, must be designed to withstand the conditions prescribed in paragraph (a) of this section. In addition, with the flaps fully extended at $V_F$, the following conditions, taken separately, must be accounted for:
   (1) A head-on gust having a velocity of 25 feet per second (EAS), combined with propeller slipstream corresponding to 75 percent of maximum continuous power; and
   (2) The effects of propeller slipstream corresponding to maximum takeoff power.

§ 23.347 Unsymmetrical flight conditions.
(a) The airplane is assumed to be subjected to the unsymmetrical flight conditions of §§ 23.349 and 23.351. Unbalanced aerodynamic moments about the center of gravity must be reacted in a rational or conservative manner, considering the principal masses furnishing the reacting inertia forces.
(b) Acrobatic category airplanes certified for flick maneuvers (snap roll) must be designed for additional asymmetric loads acting on the wing and the horizontal tail.