nearest stops or gust locks and their supporting structures.

(2) If pilot forces less than the minimums specified in § 23.397(b) are used for design, the effects of surface loads due to ground gusts and taxiing downwind must be investigated for the entire control system according to the formula:

H=K c S q

where—

H=limit hinge moment (ft.-lbs.);

c=mean chord of the control surface aft of the hinge line (ft.);

S=area of control surface aft of the hinge line (sq. ft.);

q=dynamic pressure (p.s.f.) based on a design speed not less than 14.6 $\sqrt{(W/S)}$ + 14.6 (f.p.s.) where W/S=wing loading at design maximum weight, except that the design speed need not exceed 88 (f.p.s.);

K=limit hinge moment factor for ground gusts derived in paragraph (b) of this section. (For ailerons and elevators, a positive value of K indicates a moment tending to depress the surface and a negative value of K indicates a moment tending to raise the surface).

(b) The limit hinge moment factor *K* for ground gusts must be derived as follows:

Surface	*K*	Position of controls
(a) Aileron	0.75	Control column locked lashed in mid-position.
(b) Aileron	±0.50	Ailerons at full throw; + moment on one aileron, − moment on the other.
(c) Elevator	±0.75	(c) Elevator full up (−).
(d) Elevator	....	(d) Elevator full down (+).
(e) Rudder	±0.75	(e) Rudder in neutral.
(f) Rudder	....	(f) Rudder at full throw.

(c) At all weights between the empty weight and the maximum weight declared for tie-down stated in the appropriate manual, any declared tie-down points and surrounding structure, control system, surfaces and associated gust locks, must be designed to withstand the limit load conditions that exist when the airplane is tied down and that result from wind speeds of up to 65 knots horizontally from any direction.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23–7, 34 FR 13089, Aug. 13, 1969; Amdt. 23–45, 58 FR 42160, Aug. 6, 1993; Amdt. 23–48, 61 FR 5145, Feb. 9, 1996]

HORIZONTAL STABILIZING AND BALANCING SURFACES

§ 23.421 Balancing loads.

(a) A horizontal surface balancing load is a load necessary to maintain equilibrium in any specified flight condition with no pitching acceleration.

(b) Horizontal balancing surfaces must be designed for the balancing loads occurring at any point on the limit maneuvering envelope and in the flap conditions specified in § 23.345.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23–7, 34 FR 13089, Aug. 13, 1969; Amdt. 23–42, 56 FR 352, Jan. 3, 1991]

§ 23.423 Maneuvering loads.

Each horizontal surface and its supporting structure, and the main wing of a canard or tandem wing configuration, if that surface has pitch control, must be designed for the maneuvering loads imposed by the following conditions:

(a) A sudden movement of the pitching control, at the speed V_A, to the maximum aft movement, and the maximum forward movement, as limited by the control stops, or pilot effort, whichever is critical.

(b) A sudden aft movement of the pitching control at speeds above V_A, followed by a forward movement of the pitching control resulting in the following combinations of normal and angular acceleration:

Condition	Normal acceleration (n)	Angular acceleration (radian/sec$_2$)
Nose-up pitching	1.0	$+39n_m \div V \times (n_m - 1.5)$
Nose-down pitching	n_m	$-39n_m \div V \times (n_m - 1.5)$

where—

(1) n_m=positive limit maneuvering load factor used in the design of the airplane; and

(2) V=initial speed in knots.

The conditions in this paragraph involve loads corresponding to the loads that may occur in a ‘‘checked maneuver’’ (a maneuver in which the pitching control is suddenly displaced in one direction and then suddenly moved in the opposite direction). The deflections and timing of the ‘‘checked maneuver’’ must avoid exceeding the limit maneuvering load factor. The total horizontal surface load for both nose-up and nose-down pitching conditions is the sum of the balancing loads at *V* and the specified value of the normal load factor *n*, plus the maneuvering load increment due to the specified value of the angular acceleration.

[Amdt. 23–42, 56 FR 353, Jan. 3, 1991; 56 FR 5455, Feb. 11, 1991]

§ 23.425 Gust loads.

(a) Each horizontal surface, other than a main wing, must be designed for loads resulting from—

(1) Gust velocities specified in § 23.333(c) with flaps retracted; and

(2) Positive and negative gusts of 25 f.p.s. nominal intensity at V_F corresponding to the flight conditions specified in § 23.345(a)(2).

(b) [Reserved]

(c) When determining the total load on the horizontal surfaces for the conditions specified in paragraph (a) of this section, the initial balancing loads for steady unaccelerated flight at the pertinent design speeds V_F, V_C, and V_D must first be determined. The incremental load resulting from the gusts must be added to the initial balancing load to obtain the total load.

(d) In the absence of a more rational analysis, the incremental load due to the gust must be computed as follows only on airplane configurations with aft-mounted, horizontal surfaces, unless its use elsewhere is shown to be conservative:

$$\Delta L_{ht} = \frac{K_g U_{de} V a_{ht} S_{ht}}{498}\left(1 - \frac{d\varepsilon}{d\alpha}\right)$$

where—

ΔL_{ht}=Incremental horizontal tailload (lbs.);
K_g=Gust alleviation factor defined in § 23.341;
U_{de}=Derived gust velocity (f.p.s.);
V=Airplane equivalent speed (knots);
a_{ht}=Slope of aft horizontal lift curve (per radian)
S_{ht}=Area of aft horizontal lift surface (ft^2); and

$$\left(1 - \frac{d\varepsilon}{d\alpha}\right) = \text{Downwash factor}$$

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23–7, 34 FR 13089 Aug. 13, 1969; Amdt. 23–42, 56 FR 353, Jan. 3, 1991]

§ 23.427 Unsymmetrical loads.

(a) Horizontal surfaces other than main wing and their supporting structure must be designed for unsymmetrical loads arising from yawing and slipstream effects, in combination with the loads prescribed for the flight conditions set forth in §§ 23.421 through 23.425.

(b) In the absence of more rational data for airplanes that are conventional in regard to location of engines, wings, horizontal surfaces other than main wing, and fuselage shape:

(1) 100 percent of the maximum loading from the symmetrical flight conditions may be assumed on the surface on one side of the plane of symmetry; and

(2) The following percentage of that loading must be applied to the opposite side:

Percent=100−10 (n−1), where n is the specified positive maneuvering load factor, but this value may not be more than 80 percent.

(c) For airplanes that are not conventional (such as airplanes with horizontal surfaces other than main wing having appreciable dihedral or supported by the vertical tail surfaces) the surfaces and supporting structures must be designed for combined vertical and horizontal surface loads resulting from each prescribed flight condition taken separately.

[Amdt. 23–14, 38 FR 31820, Nov. 19, 1973, as amended by Amdt. 23–42, 56 FR 353, Jan. 3, 1991]

Vertical Surfaces

§ 23.441 Maneuvering loads.

(a) At speeds up to V_A, the vertical surfaces must be designed to withstand the following conditions. In computing the loads, the yawing velocity may be assumed to be zero:

(1) With the airplane in unaccelerated flight at zero yaw, it is assumed that the rudder control is suddenly displaced to the maximum deflection, as limited by the control stops or by limit pilot forces.

(2) With the rudder deflected as specified in paragraph (a)(1) of this section, it is assumed that the airplane yaws to the overswing sideslip angle. In lieu of a rational analysis, an overswing angle