and roll resulting from the prescribed engine failure conditions.

§ 25.371 Gyroscopic loads.

The structure supporting any engine or auxiliary power unit must be designed for the loads, including gyroscopic loads, arising from the conditions specified in §§ 25.331, 25.341, 25.349, 25.351, 25.473, 25.479, and 25.481, with the engine or auxiliary power unit at the maximum rotating speed appropriate to the condition. For the purposes of compliance with this paragraph, the pitch maneuver in § 25.331(c)(1) must be carried out until the positive limit maneuvering load factor (point A_2 in § 25.333(b)) is reached.

[Amdt. 25–141, 79 FR 73468, Dec. 11, 2014]

§ 25.373 Speed control devices.

If speed control devices (such as spoilers and drag flaps) are installed for use in en route conditions—

(a) The airplane must be designed for the symmetrical maneuvers prescribed in §§ 25.333 and 25.337, the yawing maneuvers in § 25.351, and the vertical and lateral gust and turbulence conditions prescribed in § 25.341(a) and (b) at each setting and the maximum speed associated with that setting; and

(b) If the device has automatic operating or load limiting features, the airplane must be designed for the maneuver and gust conditions prescribed in paragraph (a) of this section, at the speeds and corresponding device positions that the mechanism allows.

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25–72, 55 FR 29776, July 20, 1990; Amdt. 25–86, 61 FR 5222, Feb. 9, 1996; Amdt. 25–141, 79 FR 73468, Dec. 11, 2014]

CONTROL SURFACE AND SYSTEM LOADS

§ 25.391 Control surface loads: General.

The control surfaces must be designed for the limit loads resulting from the flight conditions in §§ 25.331, 25.341(a) and (b), 25.349, and 25.351, considering the requirements for—

(a) Loads parallel to hinge line, in § 25.393;

(b) Pilot effort effects, in § 25.397;

(c) Trim tab effects, in § 25.407;

(d) Unsymmetrical loads, in § 25.427; and

(e) Auxiliary aerodynamic surfaces, in § 25.445.

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25–86, 61 FR 5222, Feb. 9, 1996; Amdt. 25–141, 79 FR 73468, Dec. 11, 2014]

§ 25.393 Loads parallel to hinge line.

(a) Control surfaces and supporting hinge brackets must be designed for inertia loads acting parallel to the hinge line.

(b) In the absence of more rational data, the inertia loads may be assumed to be equal to KW, where—

(1) $K = 24$ for vertical surfaces;

(2) $K = 12$ for horizontal surfaces; and

(3) W = weight of the movable surfaces.

§ 25.395 Control system.

(a) Longitudinal, lateral, directional, and drag control system and their supporting structures must be designed for loads corresponding to 125 percent of the computed hinge moments of the movable control surface in the conditions prescribed in § 25.391.

(b) The system limit loads of paragraph (a) of this section need not exceed the loads that can be produced by the pilot (or pilots) and by automatic or power devices operating the controls.

(c) The loads must not be less than those resulting from application of the minimum forces prescribed in § 25.397(c).

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25–23, 35 FR 5672, Apr. 8, 1970; Amdt. 25–72, 55 FR 29776, July 20, 1990; Amdt. 25–141, 79 FR 73468, Dec. 11, 2014]

§ 25.397 Control system loads.

(a) *General.* The maximum and minimum pilot forces, specified in paragraph (c) of this section, are assumed to act at the appropriate control grips or pads (in a manner simulating flight conditions) and to be reacted at the attachment of the control system to the control surface horn.

(b) *Pilot effort effects.* In the control surface flight loading condition, the air loads on movable surfaces and the corresponding deflections need not exceed those that would result in flight from the application of any pilot force within the ranges specified in paragraph (c)

of this section. Two-thirds of the maximum values specified for the aileron and elevator may be used if control surface hinge moments are based on reliable data. In applying this criterion, the effects of servo mechanisms, tabs, and automatic pilot systems, must be considered.

(c) *Limit pilot forces and torques.* The limit pilot forces and torques are as follows:

Control	Maximum forces or torques	Minimum forces or torques
Aileron:		
Stick	100 lbs	40 lbs.
Wheel [1]	80 D in.-lbs [2]	40 D in.-lbs.
Elevator:		
Stick	250 lbs	100 lbs.
Wheel (symmetrical)	300 lbs	100 lbs.
Wheel (unsymmetrical) [3]		100 lbs.
Rudder	300 lbs	130 lbs.

[1] The critical parts of the aileron control system must be designed for a single tangential force with a limit value equal to 1.25 times the couple force determined from these criteria.

[2] *D* = wheel diameter (inches).

[3] The unsymmetrical forces must be applied at one of the normal handgrip points on the periphery of the control wheel.

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25–38, 41 FR 55466, Dec. 20, 1976; Amdt. 25–72, 55 FR 29776, July 20, 1990]

§ 25.399 Dual control system.

(a) Each dual control system must be designed for the pilots operating in opposition, using individual pilot forces not less than—

(1) 0.75 times those obtained under § 25.395; or

(2) The minimum forces specified in § 25.397(c).

(b) The control system must be designed for pilot forces applied in the same direction, using individual pilot forces not less than 0.75 times those obtained under § 25.395.

§ 25.405 Secondary control system.

Secondary controls, such as wheel brake, spoiler, and tab controls, must be designed for the maximum forces that a pilot is likely to apply to those controls. The following values may be used:

PILOT CONTROL FORCE LIMITS (SECONDARY CONTROLS)

Control	Limit pilot forces
Miscellaneous:	
*Crank, wheel, or lever	((1 + R) / 3) × 50 lbs., but not less than 50 lbs. nor more than 150 lbs. (R = radius). (Applicable to any angle within 20° of plane of control).
Twist	133 in.–lbs.
Push-pull	To be chosen by applicant.

*Limited to flap, tab, stabilizer, spoiler, and landing gear operation controls.

§ 25.407 Trim tab effects.

The effects of trim tabs on the control surface design conditions must be accounted for only where the surface loads are limited by maximum pilot effort. In these cases, the tabs are considered to be deflected in the direction that would assist the pilot, and the deflections are—

(a) For elevator trim tabs, those required to trim the airplane at any point within the positive portion of the pertinent flight envelope in § 25.333(b), except as limited by the stops; and

(b) For aileron and rudder trim tabs, those required to trim the airplane in the critical unsymmetrical power and loading conditions, with appropriate allowance for rigging tolerances.

§ 25.409 Tabs.

(a) *Trim tabs.* Trim tabs must be designed to withstand loads arising from all likely combinations of tab setting, primary control position, and airplane speed (obtainable without exceeding the flight load conditions prescribed for the airplane as a whole), when the effect of the tab is opposed by pilot effort forces up to those specified in § 25.397(b).

(b) *Balancing tabs.* Balancing tabs must be designed for deflections consistent with the primary control surface loading conditions.

(c) *Servo tabs.* Servo tabs must be designed for deflections consistent with the primary control surface loading conditions obtainable within the pilot maneuvering effort, considering possible opposition from the trim tabs.

§ 25.415 Ground gust conditions.

(a) The flight control systems and surfaces must be designed for the limit