1.33 for airplanes to be approved for operation to 45,000 feet or by a factor of 1.67 for airplanes to be approved for operation above 45,000 feet, omitting other loads.

(e) Any structure, component or part, inside or outside a pressurized compartment, the failure of which could interfere with continued safe flight and landing, must be designed to withstand the effects of a sudden release of pressure through an opening in any compartment at any operating altitude resulting from each of the following conditions:

(1) The penetration of the compartment by a portion of an engine following an engine disintegration;

(2) Any opening in any pressurized compartment up to the size $H_o$ in square feet; however, small compartments may be combined with an adjacent pressurized compartment and both considered as a single compartment for openings that cannot reasonably be expected to be confined to the small compartment. The size $H_o$ must be computed by the following formula:

$$H_o=PA_s$$

where,

$H_o$=Maximum opening in square feet, need not exceed 20 square feet.

$P=(A_s/6240)+.024$

$A_s$=Maximum cross-sectional area of the pressurized shell normal to the longitudinal axis, in square feet; and

(3) The maximum opening caused by airplane or equipment failures not shown to be extremely improbable.

(f) In complying with paragraph (e) of this section, the fail-safe features of the design may be considered in determining the probability of failure or penetration and probable size of openings, provided that possible improper operation of closure devices and inadvertent door openings are also considered. Furthermore, the resulting differential pressure loads must be combined in a rational and conservative manner with 1–g level flight loads and any loads arising from emergency depressurization conditions. These loads may be considered as ultimate conditions; however, any deformations associated with these conditions must not interfere with continued safe flight and landing. The pressure relief provided by intercompartment venting may also be considered.

(g) Bulkheads, floors, and partitions in pressurized compartments for occupants must be designed to withstand the conditions specified in paragraph (e) of this section. In addition, reasonable design precautions must be taken to minimize the probability of parts becoming detached and injuring occupants while in their seats.

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25–54, 45 FR 60172, Sept. 11, 1980; Amdt. 25–71, 55 FR 13477, Apr. 10, 1990; Amdt. 25–72, 55 FR 29776, July 20, 1990; Amdt. 25–87, 61 FR 28695, June 5, 1996]

### § 25.367 Unsymmetrical loads due to engine failure.

(a) The airplane must be designed for the unsymmetrical loads resulting from the failure of the critical engine. Turbopropeller airplanes must be designed for the following conditions in combination with a single malfunction of the propeller drag limiting system, considering the probable pilot corrective action on the flight controls:

(1) At speeds between $V_{MC}$ and $V_{D,}$ the loads resulting from power failure because of fuel flow interruption are considered to be limit loads.

(2) At speeds between $V_{MC}$ and $V_{C,}$ the loads resulting from the disconnection of the engine compressor from the turbine or from loss of the turbine blades are considered to be ultimate loads.

(3) The time history of the thrust decay and drag build-up occurring as a result of the prescribed engine failures must be substantiated by test or other data applicable to the particular engine-propeller combination.

(4) The timing and magnitude of the probable pilot corrective action must be conservatively estimated, considering the characteristics of the particular engine-propeller-airplane combination.

(b) Pilot corrective action may be assumed to be initiated at the time maximum yawing velocity is reached, but not earlier than two seconds after the engine failure. The magnitude of the corrective action may be based on the control forces specified in § 25.397(b) except that lower forces may be assumed where it is shown by anaylsis or test that these forces can control the yaw 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 the gyroscopic loads arising from the conditions specified in §§ 25.331, 25.341(a), 25.349, 25.351, 25.473, 25.479, and 25.481, with the engine or auxiliary power unit at the maximum rpm appropriate to the condition. For the purposes of compliance with this section, 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. 25–91, 62 FR 40704, July 29, 1997]

**§ 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 prescribed in § 25.351, and the vertical and later gust conditions prescribed in § 25.341(a), 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]

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), 25.349 and 25.351 and the ground gust conditions in § 25.415, 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]

**§ 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, except the loads resulting from ground gusts, 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]

**§ 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