

## § 25.171

angle of bank may not exceed five degrees) at  $1.3 V_{SR1}$  during climbing flight with—

- (1) The critical engine inoperative;
- (2) The remaining engines at maximum continuous power; and
- (3) The landing gear and flaps retracted.

(e) Airplanes with four or more engines. Each airplane with four or more engines must also maintain trim in rectilinear flight with the most unfavorable center of gravity and at the climb speed, configuration, and power required by § 25.123(a) for the purpose of establishing the en route flight paths with two engines inoperative.

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-23, 35 FR 5671, Apr. 8, 1970; Amdt. 25-38, 41 FR 55466, Dec. 20, 1976; Amdt. 25-108, 67 FR 70827, Nov. 26, 2002; Amdt. 25-115, 69 FR 40527, July 2, 2004]

### STABILITY

#### § 25.171 General.

The airplane must be longitudinally, directionally, and laterally stable in accordance with the provisions of §§ 25.173 through 25.177. In addition, suitable stability and control feel (static stability) is required in any condition normally encountered in service, if flight tests show it is necessary for safe operation.

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-7, 30 FR 13117, Oct. 15, 1965]

#### § 25.173 Static longitudinal stability.

Under the conditions specified in § 25.175, the characteristics of the elevator control forces (including friction) must be as follows:

(a) A pull must be required to obtain and maintain speeds below the specified trim speed, and a push must be required to obtain and maintain speeds above the specified trim speed. This must be shown at any speed that can be obtained except speeds higher than the landing gear or wing flap operating limit speeds or  $V_{FC}/M_{FC}$ , whichever is appropriate, or lower than the minimum speed for steady unstalled flight.

(b) The airspeed must return to within 10 percent of the original trim speed for the climb, approach, and landing conditions specified in § 25.175 (a), (c),

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and (d), and must return to within 7.5 percent of the original trim speed for the cruising condition specified in § 25.175(b), when the control force is slowly released from any speed within the range specified in paragraph (a) of this section.

(c) The average gradient of the stable slope of the stick force versus speed curve may not be less than 1 pound for each 6 knots.

(d) Within the free return speed range specified in paragraph (b) of this section, it is permissible for the airplane, without control forces, to stabilize on speeds above or below the desired trim speeds if exceptional attention on the part of the pilot is not required to return to and maintain the desired trim speed and altitude.

[Amdt. 25-7, 30 FR 13117, Oct. 15, 1965]

#### § 25.175 Demonstration of static longitudinal stability.

Static longitudinal stability must be shown as follows:

(a) *Climb*. The stick force curve must have a stable slope at speeds between 85 and 115 percent of the speed at which the airplane—

- (1) Is trimmed, with—
  - (i) Wing flaps retracted;
  - (ii) Landing gear retracted;
  - (iii) Maximum takeoff weight; and
  - (iv) 75 percent of maximum continuous power for reciprocating engines or the maximum power or thrust selected by the applicant as an operating limitation for use during climb for turbine engines; and
- (2) Is trimmed at the speed for best rate-of-climb except that the speed need not be less than  $1.3 V_{SR1}$ .

(b) *Cruise*. Static longitudinal stability must be shown in the cruise condition as follows:

- (1) With the landing gear retracted at high speed, the stick force curve must have a stable slope at all speeds within a range which is the greater of 15 percent of the trim speed plus the resulting free return speed range, or 50 knots plus the resulting free return speed range, above and below the trim speed (except that the speed range need not include speeds less than  $1.3 V_{SR1}$ , nor speeds greater than  $V_{FC}/M_{FC}$ , nor speeds that require a stick force of more than 50 pounds), with—

- (i) The wing flaps retracted;
- (ii) The center of gravity in the most adverse position (see § 25.27);
- (iii) The most critical weight between the maximum takeoff and maximum landing weights;
- (iv) 75 percent of maximum continuous power for reciprocating engines or for turbine engines, the maximum cruising power selected by the applicant as an operating limitation (see § 25.1521), except that the power need not exceed that required at  $V_{MO}/M_{MO}$ ; and

(v) The airplane trimmed for level flight with the power required in paragraph (b)(1)(iv) of this section.

(2) With the landing gear retracted at low speed, the stick force curve must have a stable slope at all speeds within a range which is the greater of 15 percent of the trim speed plus the resulting free return speed range, or 50 knots plus the resulting free return speed range, above and below the trim speed (except that the speed range need not include speeds less than  $1.3 V_{SR1}$ , nor speeds greater than the minimum speed of the applicable speed range prescribed in paragraph (b)(1), nor speeds that require a stick force of more than 50 pounds), with—

(i) Wing flaps, center of gravity position, and weight as specified in paragraph (b)(1) of this section;

(ii) Power required for level flight at a speed equal to  $(V_{MO} + 1.3 V_{SR1})/2$ ; and

(iii) The airplane trimmed for level flight with the power required in paragraph (b)(2)(ii) of this section.

(3) With the landing gear extended, the stick force curve must have a stable slope at all speeds within a range which is the greater of 15 percent of the trim speed plus the resulting free return speed range, or 50 knots plus the resulting free return speed range, above and below the trim speed (except that the speed range need not include speeds less than  $1.3 V_{SR1}$ , nor speeds greater than  $V_{LE}$ , nor speeds that require a stick force of more than 50 pounds), with—

(i) Wing flap, center of gravity position, and weight as specified in paragraph (b)(1) of this section;

(ii) 75 percent of maximum continuous power for reciprocating engines or, for turbine engines, the maximum

cruising power selected by the applicant as an operating limitation, except that the power need not exceed that required for level flight at  $V_{LE}$ ; and

(iii) The aircraft trimmed for level flight with the power required in paragraph (b)(3)(ii) of this section.

(c) *Approach*. The stick force curve must have a stable slope at speeds between  $V_{SW}$  and  $1.7 V_{SR1}$ , with—

(1) Wing flaps in the approach position;

(2) Landing gear retracted;

(3) Maximum landing weight; and

(4) The airplane trimmed at  $1.3 V_{SR1}$  with enough power to maintain level flight at this speed.

(d) *Landing*. The stick force curve must have a stable slope, and the stick force may not exceed 80 pounds, at speeds between  $V_{SW}$  and  $1.7 V_{SR0}$  with—

(1) Wing flaps in the landing position;

(2) Landing gear extended;

(3) Maximum landing weight;

(4) The airplane trimmed at  $1.3 V_{SR0}$  with—

(i) Power or thrust off, and

(ii) Power or thrust for level flight.

(5) The airplane trimmed at  $1.3 V_{SR0}$  with power or thrust off.

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-7, 30 FR 13117, Oct. 15, 1965; Amdt. 25-108, 67 FR 70827, Nov. 26, 2002; Amdt. 25-115, 69 FR 40527, July 2, 2004]

#### § 25.177 Static lateral-directional stability.

(a) The static directional stability (as shown by the tendency to recover from a skid with the rudder free) must be positive for any landing gear and flap position and symmetric power condition, at speeds from  $1.13 V_{SR1}$ , up to  $V_{FE}$ ,  $V_{LE}$ , or  $V_{FC}/M_{FC}$  (as appropriate for the airplane configuration).

(b) The static lateral stability (as shown by the tendency to raise the low wing in a sideslip with the aileron controls free) for any landing gear and flap position and symmetric power condition, may not be negative at any airspeed (except that speeds higher than  $V_{FE}$  need not be considered for flaps extended configurations nor speeds higher than  $V_{LE}$  for landing gear extended configurations) in the following airspeed ranges:

(1) From  $1.13 V_{SR1}$  to  $V_{MO}/M_{MO}$ .