

§23.161

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other engines at maximum takeoff power; and

(4) The airplane trimmed at a speed equal to the greater of 1.2  $V_{S1}$  or 1.1  $V_{MC}$ , or as nearly as possible in trim for straight flight.

(c) *Approach.* It must be possible, using a favorable combination of controls, to roll the airplane from a steady 30-degree banked turn through an angle of 60 degrees, so as to reverse the direction of the turn within:

(1) For an airplane of 6,000 pounds or less maximum weight, 4 seconds from initiation of roll; and

(2) For an airplane of over 6,000 pounds maximum weight,

$(W+2,800)/2,200$

seconds, but not more than 7 seconds, where W is the weight in pounds.

(d) The requirement of paragraph (c) of this section must be met when rolling the airplane in each direction in the following conditions—

(1) Flaps in the landing position(s);

(2) Landing gear extended;

(3) All engines operating at the power for a 3 degree approach; and

(4) The airplane trimmed at  $V_{REF}$ .

[Amdt. 23-14, 38 FR 31819, Nov. 19, 1973, as amended by Amdt. 23-45, 58 FR 42158, Aug. 6, 1993; Amdt. 23-50, 61 FR 5189, Feb. 9, 1996]

TRIM

§23.161 Trim.

(a) *General.* Each airplane must meet the trim requirements of this section after being trimmed and without further pressure upon, or movement of, the primary controls or their corresponding trim controls by the pilot or the automatic pilot. In addition, it must be possible, in other conditions of loading, configuration, speed and power to ensure that the pilot will not be unduly fatigued or distracted by the need to apply residual control forces exceeding those for prolonged application of §23.143(c). This applies in normal operation of the airplane and, if applicable, to those conditions associated with the failure of one engine for which performance characteristics are established.

(b) *Lateral and directional trim.* The airplane must maintain lateral and directional trim in level flight with the

landing gear and wing flaps retracted as follows:

(1) For normal, utility, and acrobatic category airplanes, at a speed of 0.9  $V_H$ ,  $V_C$ , or  $V_{MO}/M_{MO}$ , whichever is lowest; and

(2) For commuter category airplanes, at all speeds from 1.4  $V_{S1}$  to the lesser of  $V_H$  or  $V_{MO}/M_{MO}$ .

(c) *Longitudinal trim.* The airplane must maintain longitudinal trim under each of the following conditions:

(1) A climb with—

(i) Takeoff power, landing gear retracted, wing flaps in the takeoff position(s), at the speeds used in determining the climb performance required by §23.65; and

(ii) Maximum continuous power at the speeds and in the configuration used in determining the climb performance required by §23.69(a).

(2) Level flight at all speeds from the lesser of  $V_H$  and either  $V_{NO}$  or  $V_{MO}/M_{MO}$  (as appropriate), to 1.4  $V_{S1}$ , with the landing gear and flaps retracted.

(3) A descent at  $V_{NO}$  or  $V_{MO}/M_{MO}$ , whichever is applicable, with power off and with the landing gear and flaps retracted.

(4) Approach with landing gear extended and with—

(i) A 3 degree angle of descent, with flaps retracted and at a speed of 1.4  $V_{S1}$ ;

(ii) A 3 degree angle of descent, flaps in the landing position(s) at  $V_{REF}$ ; and

(iii) An approach gradient equal to the steepest used in the landing distance demonstrations of §23.75, flaps in the landing position(s) at  $V_{REF}$ .

(d) In addition, each multiple airplane must maintain longitudinal and directional trim, and the lateral control force must not exceed 5 pounds at the speed used in complying with §23.67(a), (b)(2), or (c)(3), as appropriate, with—

(1) The critical engine inoperative, and if applicable, its propeller in the minimum drag position;

(2) The remaining engines at maximum continuous power;

(3) The landing gear retracted;

(4) Wing flaps retracted; and

(5) An angle of bank of not more than five degrees.

(e) In addition, each commuter category airplane for which, in the determination of the takeoff path in accordance with §23.57, the climb in the takeoff configuration at  $V_2$  extends beyond 400 feet above the takeoff surface, it must be possible to reduce the longitudinal and lateral control forces to 10 pounds and 5 pounds, respectively, and the directional control force must not exceed 50 pounds at  $V_2$  with—

- (1) The critical engine inoperative and its propeller in the minimum drag position;
- (2) The remaining engine(s) at takeoff power;
- (3) Landing gear retracted;
- (4) Wing flaps in the takeoff position(s); and
- (5) An angle of bank not exceeding 5 degrees.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-21, 43 FR 2318, Jan. 16, 1978; Amdt. 23-34, 52 FR 1828, Jan. 15, 1987; Amdt. 23-42, 56 FR 351, Jan. 3, 1991; 56 FR 5455, Feb. 11, 1991; Amdt. 23-50, 61 FR 5189, Feb. 9, 1996]

#### STABILITY

##### § 23.171 General.

The airplane must be longitudinally, directionally, and laterally stable under §§23.173 through 23.181. In addition, the airplane must show suitable stability and control “feel” (static stability) in any condition normally encountered in service, if flight tests show it is necessary for safe operation.

##### § 23.173 Static longitudinal stability.

Under the conditions specified in §23.175 and with the airplane trimmed as indicated, the characteristics of the elevator control forces and the friction within the control system must be as follows:

(a) A pull must be required to obtain and maintain speeds below the specified trim speed and a push required to obtain and maintain speeds above the specified trim speed. This must be shown at any speed that can be obtained, except that speeds requiring a control force in excess of 40 pounds or speeds above the maximum allowable speed or below the minimum speed for steady unstalled flight, need not be considered.

(b) The airspeed must return to within the tolerances specified for applicable categories of airplanes when the control force is slowly released at any speed within the speed range specified in paragraph (a) of this section. The applicable tolerances are—

- (1) The airspeed must return to within plus or minus 10 percent of the original trim airspeed; and
- (2) For commuter category airplanes, the airspeed must return to within plus or minus 7.5 percent of the original trim airspeed for the cruising condition specified in §23.175(b).
- (c) The stick force must vary with speed so that any substantial speed change results in a stick force clearly perceptible to the pilot.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-14, 38 FR 31820 Nov. 19, 1973; Amdt. 23-34, 52 FR 1828, Jan. 15, 1987]

##### § 23.175 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 trim speed, with—

- (1) Flaps retracted;
- (2) Landing gear retracted;
- (3) Maximum continuous power; and
- (4) The airplane trimmed at the speed used in determining the climb performance required by §23.69(a).

(b) *Cruise.* With flaps and landing gear retracted and the airplane in trim with power for level flight at representative cruising speeds at high and low altitudes, including speeds up to  $V_{NO}$  or  $V_{MO}/M_{MO}$ , as appropriate, except that the speed need not exceed  $V_H$ —

(1) For normal, utility, and acrobatic category airplanes, the stick force curve must have a stable slope at all speeds within a range that is the greater of 15 percent of the trim speed plus the resulting free return speed range, or 40 knots plus the resulting free return speed range, above and below the trim speed, except that the slope need not be stable—

- (i) At speeds less than  $1.3 V_{S1}$ ; or
- (ii) For airplanes with  $V_{NE}$  established under §23.1505(a), at speeds greater than  $V_{NE}$ ; or