

(5) The most unfavorable weight in the range of takeoff weights.

[Doc. No. 27807, 61 FR 5189, Feb. 9, 1996]

§ 23.151 Acrobatic maneuvers.

Each acrobatic and utility category airplane must be able to perform safely the acrobatic maneuvers for which certification is requested. Safe entry speeds for these maneuvers must be determined.

§ 23.153 Control during landings.

It must be possible, while in the landing configuration, to safely complete a landing without exceeding the one-hand control force limits specified in § 23.143(c) following an approach to land—

- (a) At a speed of V_{REF} minus 5 knots;
- (b) With the airplane in trim, or as nearly as possible in trim and without the trimming control being moved throughout the maneuver;
- (c) At an approach gradient equal to the steepest used in the landing distance demonstration of § 23.75; and
- (d) With only those power changes, if any, that would be made when landing normally from an approach at V_{REF} .

[Doc. No. 27807, 61 FR 5189, Feb. 9, 1996]

§ 23.155 Elevator control force in maneuvers.

(a) The elevator control force needed to achieve the positive limit maneuvering load factor may not be less than:

- (1) For wheel controls, $W/100$ (where W is the maximum weight) or 20 pounds, whichever is greater, except that it need not be greater than 50 pounds; or
- (2) For stick controls, $W/140$ (where W is the maximum weight) or 15 pounds, whichever is greater, except that it need not be greater than 35 pounds.

(b) The requirement of paragraph (a) of this section must be met at 75 percent of maximum continuous power for reciprocating engines, or the maximum continuous power for turbine engines, and with the wing flaps and landing gear retracted—

- (1) In a turn, with the trim setting used for wings level flight at V_0 ; and
- (2) In a turn with the trim setting used for the maximum wings level

flight speed, except that the speed may not exceed V_{NE} or V_{MO}/M_{MO} , whichever is appropriate.

(c) There must be no excessive decrease in the gradient of the curve of stick force versus maneuvering load factor with increasing load factor.

[Amdt. 23-14, 38 FR 31819, Nov. 19, 1973; 38 FR 32784, Nov. 28, 1973, as amended by Amdt. 23-45, 58 FR 42158, Aug. 6, 1993; Amdt. 23-50, 61 FR 5189 Feb. 9, 1996]

§ 23.157 Rate of roll.

(a) *Takeoff.* 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, 5 seconds from initiation of roll; and
- (2) For an airplane of over 6,000 pounds maximum weight,
($W+500$)/1,300

seconds, but not more than 10 seconds, where W is the weight in pounds.

(b) The requirement of paragraph (a) of this section must be met when rolling the airplane in each direction with—

- (1) Flaps in the takeoff position;
- (2) Landing gear retracted;
- (3) For a single-engine airplane, at maximum takeoff power; and for a multiengine airplane with the critical engine inoperative and the propeller in the minimum drag position, and the 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

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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

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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