Federal Aviation Regulations for Aviation Maintenance Technicians

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ACADEMIC REFERENCE ONLY

- **Includes Parts 1, 13, 21, 23, 27, 33, 34, 35, 39, 43, 45, 47, 65, 91, 121J & L, 125, 135, 145, 147, 183; and Advisory Circulars 20-109, 21-12A, 39-7B, 43-9B, 43.9-1E, and 65-11B**
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(c) *Controllable pitch propellers without constant speed controls.* Each propeller that can be controlled in flight, but that does not have constant speed controls, must have a means to limit the pitch range so that—

(1) The lowest possible pitch allows compliance with paragraph (b)(1) of this section; and

(2) The highest possible pitch allows compliance with paragraph (b)(2) of this section.

(d) *Controllable pitch propellers with constant speed controls.* Each controllable pitch propeller with constant speed controls must have—

(1) With the governor in operation, a means at the governor to limit the maximum engine speed to the maximum allowable takeoff r.p.m.; and

(2) With the governor inoperative, the propeller blades at the lowest possible pitch, with takeoff power, the airplane stationary, and no wind, either—

(i) A means to limit the maximum engine speed to 103 percent of the maximum allowable takeoff r.p.m., or

(ii) For an engine with an approved overspeed, a means to limit the maximum engine and propeller speed to not more than the maximum approved overspeed.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-45, 58 FR 42156, Aug. 6, 1993]

PERFORMANCE

§ 23.45 General.

(a) Unless otherwise prescribed, the performance requirements of this subpart must be met for still air; and

(1) Standard atmospheric conditions for normal, utility, and acrobatic category airplanes; or

(2) Ambient atmospheric conditions for commuter category airplanes.

(b) The performance data must correspond to the propulsive power or thrust available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in paragraph (d) of this section.

(c) The available propulsive thrust must correspond to engine power or thrust, not exceeding the approved power or thrust, less—

(1) Installation losses; and

(2) The power or equivalent thrust absorbed by the accessories and services appropriate to the particular ambient atmospheric conditions and the particular flight condition.

(d) The performance, as affected by engine power or thrust, must be based on a relative humidity of—

(1) 80 percent, at and below standard temperature; and

(2) 34 percent, at and above standard temperature, plus 50°F.

(3) Between the two temperatures listed in paragraphs (d)(1) and (d)(2) of this section, the relative humidity must vary linearly.

(e) For commuter category airplanes, the following also apply:

(1) Unless otherwise prescribed, the applicant must select the takeoff, en route, approach, and landing configurations for the airplane;

(2) The airplane configuration may vary with weight, altitude, and temperature, to the extent they are compatible with the operating procedures required by paragraph (e)(3) of this section;

(3) Unless otherwise prescribed, in determining the critical-engine-inoperative takeoff performance, takeoff flight path, the accelerate-stop distance, takeoff distance, and landing distance, changes in the airplane's configuration, speed, power, and thrust must be made in accordance with procedures established by the applicant for operation in service;

(4) Procedures for the execution of missed approaches and balked landings associated with the conditions prescribed in §§ 23.67(e)(3) and 23.77(c) must be established; and

(5) The procedures established under paragraphs (e)(3) and (e)(4) of this section must—

(i) Be able to be consistently executed by a crew of average skill;

(ii) Use methods or devices that are safe and reliable; and

(iii) Include allowance for any reasonably expected time delays in the execution of the procedures.

[Amdt. 23-21, 43 FR 2317, Jan. 16, 1978, as amended by Amdt. 23-34, 52 FR 1826, Jan. 15, 1987; Amdt. 23-45, 58 FR 42156, Aug. 6, 1993]

§ 23.49 Stalling speed.

(a) V_{S0} is the stalling speed, if obtainable, or the minimum steady speed, in knots (CAS), at which the airplane is controllable, with the—

(1) Applicable power or thrust condition set forth in paragraph (e) of this section;

(2) Propellers in the takeoff position;

(3) Landing gear extended;

(4) Wing flaps in the landing position;

(5) Cowl flaps closed;

(6) Center of gravity in the most unfavorable position within the allowable landing range; and

(7) Weight used when V_{S0} is being used as a factor to determine compliance with a required performance standard.

(b) Except as provided in § 23.40(c), V_{S0} at maximum weight may not exceed 61 knots for—

(1) Single-engine airplanes; and

(2) Multiengine airplanes of 6,000 pounds or less maximum weight that cannot meet the minimum rate of climb specified in § 23.67(b) with the critical engine inoperative.

(c) All single-engine airplanes, and those multiengine airplanes of 6,000 pounds or less maximum weight with a V_{S0} of more than 61 knots that do not meet the requirements of § 23.67(b)(2)(i), must comply with § 23.562(d).

(d) V_{S1} is the calibrated stalling speed, if obtainable, or the minimum steady speed, in knots, at which the airplane is controllable, with the—

(1) Applicable power or thrust condition set forth in paragraph (e) of this section;

(2) Propellers in the takeoff position;

(3) Airplane in the condition existing in the test in which V_{S1} is being used; and

(4) Weight used when V_{S1} is being used as a factor to determine compliance with a required performance standard.

(e) V_{S0} and V_{S1} must be determined by flight tests, using the procedure specified in § 23.201.

(f) The following power or thrust conditions must be used to meet the requirements of this section:

(1) For reciprocating engine-powered airplanes, engines idling, throttles closed or at not more than the power necessary for zero thrust at a speed not more than 110 percent of the stalling speed.

(2) For turbine engine-powered airplanes, the propulsive thrust may not be greater than zero at the stalling speed, or, if the resultant thrust has no appreciable effect on the stalling speed, with engines idling and throttles closed.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-7, 34 FR 13086, Aug. 13, 1969; Amdt. 23-21, 43 FR 2317, Jan. 16, 1978; Amdt. 23-44, 58 FR 38639, July 19, 1993]

§ 23.51 Takeoff.

(a) For each airplane (except a skiplane for which landplane takeoff data has been determined under this paragraph and furnished in the Airplane Flight Manual) the distance required to takeoff and climb over a 50-foot obstacle must be determined with—

(1) The engines operating within approved operating limitations; and

(2) The cowl flaps in the normal takeoff position.

(b) The starting point for measuring seaplane and amphibian takeoff distance may be the point at which a speed of not more than three knots is reached.

(c) Takeoffs made to determine the data required by this section may not require exceptional piloting skill or exceptionally favorable conditions.

(d) For commuter category airplanes, takeoff performance and data as required by §§ 23.53 through 23.59 must be determined and included in the Airplane Flight Manual—

(1) For each weight, altitude, and ambient temperature within the operational limits selected by the applicant;

(2) For the selected configuration for takeoff;

(3) For the most unfavorable center of gravity position;

(4) With the operating engine within approved operating limitations;

(5) On a smooth, dry, hard surface runway; and

(6) Corrected for the following operational correction factors:

(i) Not more than 50 percent of nominal wind components along the takeoff path opposite to the direction of takeoff and not less than 150 percent of nominal wind components along the takeoff path in the direction of takeoff; and

(ii) Effective runway gradients.

[Amdt. 23-21, 43 FR 2317, Jan. 16, 1978, as amended by Amdt. 23-34, 52 FR 1826, Jan. 15, 1987]

§ 23.53 Takeoff speeds.

(a) For multiengine normal, utility, and acrobatic category airplanes, the rotation speed, V_R, may not be less than V_{MC} determined in accordance with § 23.149.

(b) Each normal, utility, and acrobatic category airplane, upon reaching a height of 50 feet above the takeoff surface level, must have reached a speed of not less than the following:

(1) For multiengine airplanes, the higher of—

(i) 1.1 V_{MC}; or

(ii) Any lesser speed, not less than 1.2 V_{S1}, that is shown to be safe for continued flight or land-back, if applicable, under all conditions, including turbulence and complete failure of the critical engine.

(2) For single-engine airplanes, any speed, not less than 1.2 V_{S1}, that is shown to be safe under all conditions, including turbulence and complete engine failure.

(c) For commuter category airplanes, the following apply:

(1) The takeoff decision speed, V_1, is the calibrated airspeed on the ground at which, as a result of engine failure or other reasons, the pilot is assumed to have made a decision to continue or discontinue the takeoff. The takeoff decision speed, V_1, must be selected by the applicant but may not be less than the greater of the following:

(i) 1.10 V_{S1};

§ 23.181 Dynamic stability.

(a) Any short period oscillation not including combined lateral-directional oscillations occurring between the stalling speed and the maximum allowable speed appropriate to the configuration of the airplane must be heavily damped with the primary controls—

(1) Free; and

(2) In a fixed position.

(b) Any combined lateral-directional oscillations ("Dutch roll") occurring between the stalling speed and the maximum allowable speed appropriate to the configuration of the airplane must be damped to 1/10 amplitude in 7 cycles with the primary controls—

(1) Free; and

(2) In a fixed position.

(c) If it is determined that the function of a stability augmentation system. reference § 23.672, is needed to meet the flight characteristic requirements of this part, the primary control requirements of paragraphs (a)(2) and (b)(2) of this section are not applicable to the tests needed to verify the acceptability of that system.

(d) During the conditions as specified in § 23.175, when the longitudinal control force required to maintain speeds differing from the trim speed by at least plus and minus 15 percent is suddenly released, the response of the airplane must not exhibit any dangerous characteristics nor be excessive in relation to the magnitude of the control force released. Any long-period oscillation of flight path, phugoid oscillation, that results must not be so unstable as to increase the pilot's workload or otherwise endanger the airplane.

[Amdt. 23-21, 43 FR 2318, Jan. 16, 1978; as amended by Amdt. 23-45, 58 FR 42158, Aug. 6, 1993]

STALLS

§ 23.201 Wings level stall.

(a) For an airplane with independently controlled roll and directional controls, it must be possible to produce and to correct roll by unreversed use of the rolling control and to produce and to correct yaw by unreversed use of the directional control, up to the time the airplane pitches.

(b) For an airplane with interconnected lateral and directional controls (2 controls) and for an airplane with only one of these controls, it must be possible to produce and correct roll by unreversed use of the rolling control without producing excessive yaw, up to the time the airplane pitches.

(c) The wings level stall characteristics must be demonstrated in flight as follows: Starting from a speed above the stall warning speed, the elevator control must be pulled back so that the rate of speed reduction will not exceed one knot per second until a stall is produced, as shown by an uncontrollable downward pitching motion of the airplane, until the control reaches the stop or until the activation of an artificial stall barrier, for example, stick pusher. Normal use of the elevator control for recovery is allowed after the pitching motion has unmistakably developed or after the control has been held against the stop for not less than two seconds. In addition, engine power may not be increased for recovery until the speed has increased to approximately 1.2 V_{S1}.

(d) Except where made inapplicable by the special features of a particular type of airplane, the following apply to the measurement of loss of altitude during a stall:

(1) The loss of altitude encountered in the stall (power on or power off) is the change in altitude (as observed on the sensitive altimeter testing installation) between the altitude at which the airplane pitches and the altitude at which horizontal flight is regained.

(2) If power is required during stall recovery, the power used must be that used under the normal operating procedures selected by the applicant for this maneuver; however, the power used to regain level flight may not be increased until the speed has increased to approximately 1.2 V_{S1}.

(e) During the recovery part of the maneuver, it must be possible to prevent more than 15 degrees of roll or yaw by the normal use of controls.

(f) Compliance with the requirements of this section must be shown under the following conditions:

(1) *Wing flaps:* Full up, full down, and intermediate, if appropriate.

(2) *Landing gear:* Retracted and extended.

(3) *Cowl flaps:* Appropriate to configuration.

(4) *Power:* Power off, and 75 percent maximum continuous power. If the power-to-weight ratio at 75 percent continuous power provides undesirable stall characteristics at extremely nose high attitudes, the test may be accomplished with the power or thrust required for level flight in the landing configuration at maximum landing weight and a speed of 1.4 V_{S0}, but the power may not be less than 50 percent of maximum continuous power.

(5) *Trim:* The airplane trimmed at a speed as near 1.5 V_{S1} as practicable.

(6) *Propeller:* Full increase rpm position for the power off condition.

[Amdt. 23-14, 38 FR 31820, Nov. 19, 1973; as amended by Amdt. 23-45, 58 FR 42159, Aug. 6, 1993; 58 FR 51970, Oct. 5, 1993]

§ 23.203 Turning flight and accelerated stalls.

Turning flight and accelerated stalls must be demonstrated in flight tests as follows:

(a) Establish and maintain a coordinated turn in a 30 degree bank. Reduce speed by steadily and progressively tightening the turn with the elevator until the airplane is stalled or until the elevator has reached its stop. The rate of speed reduction must be constant, and:

(1) For a turning flight stall, may not exceed one knot per second; and

(2) For an accelerated stall, be 3 to 5 knots per second with steadily increasing normal acceleration.

(b) When the stall has fully developed or the elevator has reached its stop, it must be possible to regain wings level flight by normal use of the flight controls but without increasing power and without—

(1) Excessive loss of altitude;

(2) Undue pitchup;

(3) Uncontrollable tendency to spin;

(4) Exceeding a bank angle of 60 degrees in the original direction of the turn or 30 degrees in the opposite direction in the case of turning flight stalls, and without exceeding a bank angle of 90 degrees in the original direction of the turn or 60 degrees in the opposite direction in the case of accelerated stalls; and

(5) Exceeding the maximum permissible speed or allowable load factor.

(c) Compliance with the requirements of this section must be shown with:

(1) *Wing Flaps:* Retracted, fully extended, and in each intermediate position, as appropriate.

(2) *Landing gear:* Retracted and extended;

(3) *Cowl flaps:* Appropriate to configuration;

(4) *Power:* Power or thrust off, and 75 percent maximum continuous power or thrust. If the power-to-weight ratio at 75 percent continuous power or thrust provides undesirable stall characteristics at extremely nose-high attitudes, the test may be accomplished with the power or thrust required for level flight in the landing configuration at maximum landing weight and a speed of 1.4 V_{S0} but the power may not be less than 50 percent of maximum continuous power.

(5) *Trim:* The airplane trimmed at a speed as near 1.5 V_{S1} as practicable.

[Amdt. 23-14, 38 FR 31820, Nov. 19, 1973; as amended by Amdt. 23-45, 58 FR 42159, Aug. 6, 1993]

§ 23.205 Critical engine inoperative stalls.

(a) A multiengine airplane may not display any undue spinning tendency and must be safely recoverable without applying power to the inoperative engine when stalled. The operating engines may be throttled back during the recovery from stall.

(b) Compliance with paragraph (a) of the section must be shown with:

(1) *Wing flaps:* Retracted and set to the position used to show compliance with § 23.67.

(2) *Landing gear:* Retracted.

(3) *Cowl flaps:* Appropriate to level flight critical engine inoperative.

(4) *Power:* Critical engine inoperative and the remaining engine(s) at 75 percent maximum continuous power or thrust or the power or thrust at which the use of maximum control travel just holds the wings laterally level in the approach to stall, whichever is lesser.

(5) *Propeller:* Normal inoperative position for the inoperative engine.

(6) *Trim:* Level flight, critical engine inoperative, except that for an airplane of 6,000 pounds or less maximum weight that has a stalling speed of 61 knots or less and cannot maintain level flight with the critical engine inoperative, the airplane must be trimmed for straight flight, critical engine inoperative, at a speed as near 1.5 V_{S1} as practicable,

[Amdt. 23-14, 38 FR 31820, Nov. 19, 1973; as amended by Amdt. 23-45, 58 FR 42159, Aug. 6, 1993]

§ 23.207 Stall warning.

(a) There must be a clear and distinctive stall warning, with the flaps and landing gear in any normal position, in straight and turning flight.

(b) The stall warning may be furnished either through the inherent aerodynamic qualities of the airplane or by a device that will give clearly distinguishable indications under expected conditions of flight. However, a visual stall warning device that requires the attention of the crew within the cockpit is not acceptable by itself.

(c) For the stall tests required by § 23.201(c), the stall warning must begin at a speed exceeding the stalling speed by a margin of not less than 5 knots, but not more than the greater of 10 knots or 15 percent of the stalling speed, and must continue until the stall occurs.

(d) For all other stall tests, the stall warning must begin at not less than 5 knots above the stall speed and be sufficiently in advance of the stall for the stall to be averted by action after the stall warning first occurs. In addition, when following

the procedures of § 23.1585, the stall warning must not operate during a normal takeoff, a takeoff continued with one engine inoperative or approach to landing.

[Amdt. 23-7, 34 FR 13087, Aug. 13, 1969; as amended by Amdt. 23-45, 58 FR 42159, Aug. 6, 1993]

SPINNING

§ 23.221 Spinning.

(a) *Normal category.* Except as provided in paragraph (d) of this section, a single-engine, normal category airplane must demonstrate compliance with either the one-turn spin or the spin-resistant requirements of this paragraph.

(1) One-turn spin. The airplane must recover from a one-turn spin or a three-second spin, whichever takes longer, in not more than one additional turn after the controls have been applied for recovery. In addition—

(i) For both the flaps-retracted and flaps-extended conditions, the applicable airspeed limit and positive limit maneuvering load factor must not be exceeded;

(ii) There must be no excessive back pressure during the spin or recovery;

(iii) It must be impossible to obtain unrecoverable spins with any use of the flight or engine power controls either at the entry into or during the spin; and

(iv) For the flaps-extended condition, the flaps may be retracted during the recovery, but not before rotation has ceased.

(2) Spin resistant. The airplane must be demonstrated to be spin resistant by the following:

(i) During the stall maneuvers contained in § 23.201, the pitch control must be pulled back and held against the stop. Then, using ailerons and rudders in the proper direction, it must be possible to maintain wings-level flight within 15 degrees of bank and to roll the airplane from a 30-degree bank in one direction to a 30-degree bank in the other direction;

(ii) Reduce the airplane speed using pitch control at a rate of approximately 1 knot per second until the pitch control reaches the stop; then with the pitch control pulled back and held against the stop, apply full rudder control in a manner to promote spin entry, for a period of 7 seconds or through a 360-degree heading change, whichever occurs first. If the 360-degree heading change is reached first, it must have taken no fewer than 4 seconds. This maneuver must be performed first with the ailerons in the neutral position, and then with the ailerons deflected opposite the direction of turn in the most adverse manner. Power or thrust and airplane configuration must be set in accordance with § 23.201(f) without change during the maneuver. At the end of 7 seconds or a 360-degree heading change, the airplane must respond immediately and normally to primary flight controls applied to regain coordinated, unstalled flight without reversal of control effect and without exceeding the temporary control forces specified by § 23.143(c); and

(iii) Compliance with §§ 23.201 and 23.203 must be demonstrated with the airplane in uncoordinated flight, corresponding to one ball width displacement on a slip-skid indicator, unless one ball width displacement cannot be obtained with full rudder, in which case the demonstration must be with full rudder applied.

(b) *Utility category.* A utility category airplane must meet the requirements of paragraph (a) of this section or the requirements of paragraph (c) of this section if approval for spinning is requested.

(c) *Acrobatic category.* An acrobatic category airplane must meet the following requirements:

(1) The airplane must recover from any point in a spin, in not more than one and one-half additional turns after normal recovery application of the controls. Prior to normal recovery application of the controls, the spin test must proceed for six turns or 3 seconds, whichever takes longer, with flaps retracted, and one turn or 3 seconds, whichever takes longer, with flaps extended. However, beyond 3 seconds, the spin may be discontinued when spiral characteristics appear with flaps retracted.

(2) For both the flaps-retracted and flaps-extended conditions, the applicable airspeed limit and positive limit maneuvering load factor may not be exceeded. For the flaps-extended condition, the flaps may be retracted during recovery, if a placard is installed prohibiting intentional spins with flaps extended.

(3) It must be impossible to obtain unrecoverable spins with any use of the flight or engine power controls either at the entry into or during the spin.

(d) *Airplanes "characteristically incapable of spinning".* If it is desired to designate an airplane as "characteristically incapable of spinning", this characteristic must be shown with—

(1) A weight five percent more than the highest weight for which approval is requested;

(2) A center of gravity at least three percent aft of the rearmost position for which approval is requested;

(3) An available elevator up-travel four degrees in excess of that to which the elevator travel is to be limited for approval; and