

temperature at which compliance with the cooling provisions of § 23.1041 to § 23.1047 is shown, if lower.

(c) Performance data must be determined with the cowl flaps or other means for controlling the engine cooling air supply in the position used in the cooling tests required by § 23.1041 to § 23.1047.

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

(1) Installation losses; and

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

(e) The performance, as affected by engine power or thrust, must be based on a relative humidity:

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

(2) From 80 percent, at the standard temperature, varying linearly down to 34 percent at the standard temperature plus 50 °F.

(f) Unless otherwise prescribed, in determining the takeoff and landing distances, changes in the airplane's configuration, speed, and power must be made in accordance with procedures established by the applicant for operation in service. These procedures must be able to be executed consistently by pilots of average skill in atmospheric conditions reasonably expected to be encountered in service.

(g) The following, as applicable, must be determined on a smooth, dry, hard-surfaced runway—

(1) Takeoff distance of § 23.53(b);

(2) Accelerate-stop distance of § 23.55;

(3) Takeoff distance and takeoff run of § 23.59; and

(4) Landing distance of § 23.75.

NOTE: The effect on these distances of operation on other types of surfaces (for example, grass, gravel) when dry, may be determined or derived and these surfaces listed in the Airplane Flight Manual in accordance with § 23.1583(p).

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

(1) Unless otherwise prescribed, the applicant must select the takeoff, enroute, approach, and landing configurations for the airplane.

(2) The airplane configuration may vary with weight, altitude, and tem-

perature, to the extent that they are compatible with the operating procedures required by paragraph (h)(3) of this section.

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

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

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

(i) Be able to be consistently executed by a crew of average skill in atmospheric conditions reasonably expected to be encountered in service;

(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.

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#### § 23.49 Stalling period.

(a)  $V_{SO}$  and  $V_{S1}$  are the stalling speeds or the minimum steady flight speeds, in knots (CAS), at which the airplane is controllable with—

(1) For reciprocating engine-powered airplanes, the engine(s) idling, the throttle(s) 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 not greater than zero at the stalling speed, or, if the resultant thrust has no appreciable effect on the stalling speed, with engine(s) idling and throttle(s) closed;

(3) The propeller(s) in the takeoff position;

(4) The airplane in the condition existing in the test, in which  $V_{SO}$  and  $V_{S1}$  are being used;

(5) The center of gravity in the position that results in the highest value of  $V_{SO}$  and  $V_{S1}$ ; and

(6) The weight used when  $V_{SO}$  and  $V_{S1}$  are being used as a factor to determine

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compliance with a required performance standard.

(b)  $V_{SO}$  and  $V_{S1}$  must be determined by flight tests, using the procedure and meeting the flight characteristics specified in § 23.201.

(c) Except as provided in paragraph (d) of this section,  $V_{SO}$  and  $V_{S1}$  at maximum weight must 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(a) (1) with the critical engine inoperative.

(d) All single-engine airplanes, and those multiengine airplanes of 6,000 pounds or less maximum weight with a  $V_{SO}$  of more than 61 knots that do not meet the requirements of § 23.67(a)(1), must comply with § 23.562(d).

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### § 23.51 Takeoff speeds.

(a) For normal, utility, and acrobatic category airplanes, rotation speed,  $V_R$ , is the speed at which the pilot makes a control input, with the intention of lifting the airplane out of contact with the runway or water surface.

(1) For multiengine landplanes,  $V_R$ , must not be less than the greater of  $1.05 V_{MC}$ ; or  $1.10 V_{S1}$ ;

(2) For single-engine landplanes,  $V_R$ , must not be less than  $V_{S1}$ ; and

(3) For seaplanes and amphibians taking off from water,  $V_R$ , may be any speed that is shown to be safe under all reasonably expected conditions, including turbulence and complete failure of the critical engine.

(b) For normal, utility, and acrobatic category airplanes, the speed at 50 feet above the takeoff surface level must not be less than:

(1) or multiengine airplanes, the highest of—

(i) A speed that is shown to be safe for continued flight (or emergency landing, if applicable) under all reasonably expected conditions, including turbulence and complete failure of the critical engine;

(ii)  $1.10 V_{MC}$ ; or

(iii)  $1.20 V_{S1}$ .

(2) For single-engine airplanes, the higher of—

(i) A speed that is shown to be safe under all reasonably expected conditions, including turbulence and complete engine failure; or

(ii)  $1.20 V_{S1}$ .

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

(1)  $V_1$  must be established in relation to  $V_{EF}$  as follows:

(i)  $V_{EF}$  is the calibrated airspeed at which the critical engine is assumed to fail.  $V_{EF}$  must be selected by the applicant but must not be less than  $1.05 V_{MC}$  determined under § 23.149(b) or, at the option of the applicant, not less than  $V_{MCG}$  determined under § 23.149(f).

(ii) 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 must not be less than  $V_{EF}$  plus the speed gained with the critical engine inoperative during the time interval between the instant at which the critical engine is failed and the instant at which the pilot recognizes and reacts to the engine failure, as indicated by the pilot's application of the first retarding means during the accelerate-stop determination of § 23.55.

(2) The rotation speed,  $V_R$ , in terms of calibrated airspeed, must be selected by the applicant and must not be less than the greatest of the following:

(i)  $V_1$ ;

(ii)  $1.05 V_{MC}$  determined under § 23.149(b);

(iii)  $1.10 V_{S1}$ ; or

(iv) The speed that allows attaining the initial climb-out speed,  $V_2$ , before reaching a height of 35 feet above the takeoff surface in accordance with § 23.57(c)(2).

(3) For any given set of conditions, such as weight, altitude, temperature, and configuration, a single value of  $V_R$  must be used to show compliance with both the one-engine-inoperative takeoff and all-engines-operating takeoff requirements.

(4) The takeoff safety speed,  $V_2$ , in terms of calibrated airspeed, must be selected by the applicant so as to allow the gradient of climb required in § 23.67(c)(1) and (c)(2) but must not be less than  $1.10 V_{MC}$  or less than  $1.20 V_{S1}$ .