

**§ 25.27**

**§ 25.27 Center of gravity limits.**

The extreme forward and the extreme aft center of gravity limitations must be established for each practicably separable operating condition. No such limit may lie beyond—

- (a) The extremes selected by the applicant;
- (b) The extremes within which the structure is proven; or
- (c) The extremes within which compliance with each applicable flight requirement is shown.

**§ 25.29 Empty weight and corresponding center of gravity.**

(a) The empty weight and corresponding center of gravity must be determined by weighing the airplane with—

- (1) Fixed ballast;
- (2) Unusable fuel determined under § 25.959; and
- (3) Full operating fluids, including—
  - (i) Oil;
  - (ii) Hydraulic fluid; and
  - (iii) Other fluids required for normal operation of airplane systems, except potable water, lavatory precharge water, and fluids intended for injection in the engine.
- (b) The condition of the airplane at the time of determining empty weight must be one that is well defined and can be easily repeated.

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-42, 43 FR 2320, Jan. 16, 1978; Amdt. 25-72, 55 FR 29774, July 20, 1990]

**§ 25.31 Removable ballast.**

Removable ballast may be used on showing compliance with the flight requirements of this subpart.

**§ 25.33 Propeller speed and pitch limits.**

(a) The propeller speed and pitch must be limited to values that will ensure—

- (1) Safe operation under normal operating conditions; and
- (2) Compliance with the performance requirements of §§ 25.101 through 25.125.
- (b) There must be a propeller speed limiting means at the governor. It must limit the maximum possible governed engine speed to a value not exceeding the maximum allowable r.p.m.

(c) The means used to limit the low pitch position of the propeller blades must be set so that the engine does not exceed 103 percent of the maximum allowable engine rpm or 99 percent of an approved maximum overspeed, whichever is greater, with—

- (1) The propeller blades at the low pitch limit and governor inoperative;
- (2) The airplane stationary under standard atmospheric conditions with no wind; and
- (3) The engines operating at the take-off manifold pressure limit for reciprocating engine powered airplanes or the maximum takeoff torque limit for turbopropeller engine-powered airplanes.

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-57, 49 FR 6848, Feb. 23, 1984; Amdt. 25-72, 55 FR 29774, July 20, 1990]

**PERFORMANCE**

**§ 25.101 General.**

(a) Unless otherwise prescribed, airplanes must meet the applicable performance requirements of this subpart for ambient atmospheric conditions and still air.

(b) The performance, as affected by engine power or thrust, must be based on the following relative humidities:

- (1) For turbine engine powered airplanes, a relative humidity of—
  - (i) 80 percent, at and below standard temperatures; and
  - (ii) 34 percent, at and above standard temperatures plus 50 °F.

Between these two temperatures, the relative humidity must vary linearly.

(2) For reciprocating engine powered airplanes, a relative humidity of 80 percent in a standard atmosphere. Engine power corrections for vapor pressure must be made in accordance with the following table:

Altitude <i>H</i> (ft.)	Vapor pressure <i>e</i> (In. Hg.)	Specific humidity <i>w</i> (Lb. moisture per lb. dry air)	Density ratio $\rho / \sigma = 0.0023769$
0	0.403	0.00849	0.99508
1,000	.354	.00773	.96672
2,000	.311	.00703	.93895
3,000	.272	.00638	.91178
4,000	.238	.00578	.88514
5,000	.207	.00523	.85910
6,000	.1805	.00472	.83361
7,000	.1566	.00425	.80870
8,000	.1356	.00382	.78434
9,000	.1172	.00343	.76053
10,000	.1010	.00307	.73722
15,000	.0463	.001710	.62868

Altitude H (ft.)	Vapor pressure e (In. Hg.)	Specific humidity w (Lb. moisture per lb. dry air)	Density ratio $\rho / \sigma = 0.0023769$
20,000	.01978	.000896	.53263
25,000	.00778	.000436	.44806

(c) The performance must correspond to the propulsive thrust available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in paragraph (b) of this section. 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) Unless otherwise prescribed, the applicant must select the takeoff, en route, approach, and landing configurations for the airplane.

(e) The airplane configurations may vary with weight, altitude, and temperature, to the extent they are compatible with the operating procedures required by paragraph (f) of this section.

(f) Unless otherwise prescribed, in determining the accelerate-stop distances, takeoff flight paths, takeoff distances, and landing distances, 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.

(g) Procedures for the execution of balked landings and missed approaches associated with the conditions prescribed in §§25.119 and 25.121(d) must be established.

(h) The procedures established under paragraphs (f) and (g) of this section must—

(1) Be able to be consistently executed in service by crews of average skill;

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

(3) Include allowance for any time delays, in the execution of the procedures, that may reasonably be expected in service.

(i) The accelerate-stop and landing distances prescribed in §§25.109 and

25.125, respectively, must be determined with all the airplane wheel brake assemblies at the fully worn limit of their allowable wear range.

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-38, 41 FR 55466, Dec. 20, 1976; Amdt. 25-92, 63 FR 8318, Feb. 18, 1998]

**§ 25.103 Stall speed.**

(a) The reference stall speed,  $V_{SR}$ , is a calibrated airspeed defined by the applicant.  $V_{SR}$  may not be less than a 1-g stall speed.  $V_{SR}$  is expressed as:

$$V_{SR} \geq \frac{V_{CLMAX}}{\sqrt{n_{ZW}}}$$

where:

$V_{CLMAX}$  = Calibrated airspeed obtained when the load factor-corrected lift coefficient

$$\left( \frac{n_{ZW}W}{qS} \right)$$

is first a maximum during the maneuver prescribed in paragraph (c) of this section. In addition, when the maneuver is limited by a device that abruptly pushes the nose down at a selected angle of attack (e.g., a stick pusher),  $V_{CLMAX}$  may not be less than the speed existing at the instant the device operates;

$n_{ZW}$  = Load factor normal to the flight path at  $V_{CLMAX}$

W = Airplane gross weight;

S = Aerodynamic reference wing area; and

q = Dynamic pressure.

(b)  $V_{CLMAX}$  is determined with:

(1) Engines idling, or, if that resultant thrust causes an appreciable decrease in stall speed, not more than zero thrust at the stall speed;

(2) Propeller pitch controls (if applicable) in the takeoff position;

(3) The airplane in other respects (such as flaps and landing gear) in the condition existing in the test or performance standard in which  $V_{SR}$  is being used;

(4) The weight used when  $V_{SR}$  is being used as a factor to determine compliance with a required performance standard;

(5) The center of gravity position that results in the highest value of reference stall speed; and

(6) The airplane trimmed for straight flight at a speed selected by the applicant, but not less than  $1.13V_{SR}$  and not greater than  $1.3V_{SR}$ .