§ 29.173 Static longitudinal stability.

(a) The longitudinal control must be designed so that a rearward movement of the control is necessary to obtain a speed less than the trim speed, and a forward movement of the control is necessary to obtain a speed more than the trim speed.

(b) With the throttle and collective pitch held constant during the maneuvers specified in § 29.175 (a) through (c), the slope of the control position versus speed curve must be positive throughout the full range of altitude for which certification is requested.

(c) During the maneuver specified in § 29.175(d), the longitudinal control position versus speed curve may have a negative slope within the specified speed range if the negative motion is not greater than 10 percent of total control travel.

[Amdt. 29–24, 49 FR 44436, Nov. 6, 1984]

§ 29.175 Demonstration of static longitudinal stability.

(a) *Climb.* Static longitudinal stability must be shown in the climb condition at speeds from 0.85 V_Y, or 15 knots below V_Y, whichever is less, to 1.2 V_Y or 15 knots above V_Y, whichever is greater, with—

(1) Critical weight;

(2) Critical center of gravity;

(3) Maximum continuous power;

(4) The landing gear retracted; and

(5) The rotorcraft trimmed at V_Y.

(b) *Cruise.* Static longitudinal stability must be shown in the cruise condition at speeds from 0.7 V_H or 0.7 V_{NE}, whichever is less, to 1.1 V_H or 1.1 V_{NE}, whichever is less, with—

(1) Critical weight;

(2) Critical center of gravity;

(3) Power for level flight at 0.9 V_H or 0.9 V_{NE}, whichever is less;

(4) The landing gear retracted, and

(5) The rotorcraft trimmed at 0.9 V_H or 0.9 V_{NE}, whichever is less.

(c) *Autorotation.* Static longitudinal stability must be shown in autorotation at airspeeds from 0.5 times the speed for minimum rate of descent, or 0.5 times the maximum range glide speed for Category A rotorcraft, to V_{NE} or to 1.1 V_{NE} (power-off) if V_{NE} (power-off) is established under § 29.1505(c), and with—

(1) Critical weight;

(2) Critical center of gravity;

(3) Power off;

(4) The landing gear—

(i) Retracted; and

(ii) Extended; and

(5) The rotorcraft trimmed at appropriate speeds found necessary by the Administrator to demonstrate stability throughout the prescribed speed range.

(d) *Hovering.* For helicopters, the longitudinal cyclic control must operate with the sense, direction of motion, and position as prescribed in § 29.173 between the maximum approved rearward speed and a forward speed of 17 knots with—

(1) Critical weight;

(2) Critical center of gravity;

(3) Power required to maintain an approximate constant height in ground effect;

(4) The landing gear extended; and

(5) The helicopter trimmed for hovering.

(Secs. 313(a), 601, 603, 604, and 605 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424, and 1425); and sec. 6(c), Dept. of Transportation Act (49 U.S.C. 1655(c)))

[Doc. No. 5084, 29 FR 16150, Dec. 3, 1964, as amended by Amdt. 29–3, 33 FR 966, Jan. 26, 1968; Amdt. 29–12, 41 FR 55471, Dec. 20, 1976; Amdt. 29–15, 43 FR 2327, Jan. 16, 1978; Amdt. 29–24, 49 FR 44436, Nov. 6, 1984]

§ 29.177 Static directional stability.

Static directional stability must be positive with throttle and collective controls held constant at the trim conditions specified in § 29.175 (a), (b), and (c). Sideslip angle must increase steadily with directional control deflection for sideslip angles up to ±10° from trim. Sufficient cues must accompany sideslip to alert the pilot when approaching sideslip limits.

[Amdt. 29–24, 49 FR 44436, Nov. 6, 1984]

§ 29.181 Dynamic stability: Category A rotorcraft.

Any short-period oscillation occurring at any speed from V_Y to V_{NE} must be positively damped with the primary flight controls free and in a fixed position.

[Amdt. 29–24, 49 FR 44437, Nov. 6, 1984]

GROUND AND WATER HANDLING CHARACTERISTICS

§ 29.231 General.

The rotorcraft must have satisfactory ground and water handling characteristics, including freedom from uncontrollable tendencies in any condition expected in operation.

§ 29.235 Taxiing condition.

The rotorcraft must be designed to withstand the loads that would occur when the rotorcraft is taxied over the roughest ground that may reasonably be expected in normal operation.

§ 29.239 Spray characteristics.

If certification for water operation is requested, no spray characteristics during taxiing, takeoff, or landing may obscure the vision of the pilot or damage the rotors, propellers, or other parts of the rotorcraft.

§ 29.241 Ground resonance.

The rotorcraft may have no dangerous tendency to oscillate on the ground with the rotor turning.

MISCELLANEOUS FLIGHT REQUIREMENTS

§ 29.251 Vibration.

Each part of the rotorcraft must be free from excessive vibration under each appropriate speed and power condition.

Subpart C—Strength Requirements

GENERAL

§ 29.301 Loads.

(a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads.

(b) Unless otherwise provided, the specified air, ground, and water loads must be placed in equilibrium with inertia forces, considering each item of mass in the rotorcraft. These loads must be distributed to closely approximate or conservatively represent actual conditions.

(c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account.

§ 29.303 Factor of safety.

Unless otherwise provided, a factor of safety of 1.5 must be used. This factor applies to external and inertia loads unless its application to the resulting internal stresses is more conservative.

§ 29.305 Strength and deformation.

(a) The structure must be able to support limit loads without detrimental or permanent deformation. At any load up to limit loads, the deformation may not interfere with safe operation.

(b) The structure must be able to support ultimate loads without failure. This must be shown by—

(1) Applying ultimate loads to the structure in a static test for at least three seconds; or

(2) Dynamic tests simulating actual load application.

§ 29.307 Proof of structure.

(a) Compliance with the strength and deformation requirements of this subpart must be shown for each critical loading condition accounting for the environment to which the structure will be exposed in operation. Structural analysis (static or fatigue) may be used only if the structure conforms to those structures for which experience has shown this method to be reliable. In other cases, substantiating load tests must be made.

(b) Proof of compliance with the strength requirements of this subpart must include—

(1) Dynamic and endurance tests of rotors, rotor drives, and rotor controls;

(2) Limit load tests of the control system, including control surfaces;

(3) Operation tests of the control system;

(4) Flight stress measurement tests;

(5) Landing gear drop tests; and

(6) Any additional tests required for new or unusual design features.

(Secs. 604, 605, 72 Stat. 778, 49 U.S.C. 1424, 1425)

[Doc. No. 5084, 29 FR 16150, Dec. 3, 1964, as amended by Amdt. 29–4, 33 FR 14106, Sept. 18, 1968; Amdt. 27–26, 55 FR 8001, Mar. 6, 1990]