

## § 29.361

(b) To produce the load required in paragraph (a) of this section, in unaccelerated flight with zero yaw, at forward speeds from zero up to  $0.6 V_{NE}$ —

(1) Displace the cockpit directional control suddenly to the maximum deflection limited by the control stops or by the maximum pilot force specified in § 29.397(a);

(2) Attain a resulting sideslip angle or  $90^\circ$ , whichever is less; and

(3) Return the directional control suddenly to neutral.

(c) To produce the load required in paragraph (a) of the section, in unaccelerated flight with zero yaw, at forward speeds from  $0.6 V_{NE}$  up to  $V_{NE}$  or  $V_H$ , whichever is less—

(1) Displace the cockpit directional control suddenly to the maximum deflection limited by the control stops or by the maximum pilot force specified in § 29.397(a);

(2) Attain a resulting sideslip angle or  $15^\circ$ , whichever is less, at the lesser speed of  $V_{NE}$  or  $V_H$ ;

(3) Vary the sideslip angles of paragraphs (b)(2) and (c)(2) of this section directly with speed; and

(4) Return the directional control suddenly to neutral.

[Amdt. 29-26, 55 FR 8002, Mar. 6, 1990, as amended by Amdt. 29-41, 62 FR 46173, Aug. 29, 1997]

## § 29.361 Engine torque.

The limit engine torque may not be less than the following:

(a) For turbine engines, the highest of—

(1) The mean torque for maximum continuous power multiplied by 1.25;

(2) The torque required by § 29.923;

(3) The torque required by § 29.927; or

(4) The torque imposed by sudden engine stoppage due to malfunction or structural failure (such as compressor jamming).

(b) For reciprocating engines, the mean torque for maximum continuous power multiplied by—

(1) 1.33, for engines with five or more cylinders; and

(2) Two, three, and four, for engines with four, three, and two cylinders, respectively.

[Amdt. 29-26, 53 FR 34215, Sept. 2, 1988]

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### CONTROL SURFACE AND SYSTEM LOADS

#### § 29.391 General.

Each auxiliary rotor, each fixed or movable stabilizing or control surface, and each system operating any flight control must meet the requirements of §§ 29.395 through 29.399, 29.411, and 29.427.

[Amdt. 29-26, 55 FR 8002, Mar. 6, 1990, as amended by Amdt. 29-41, 62 FR 46173, Aug. 29, 1997]

#### § 29.395 Control system.

(a) The reaction to the loads prescribed in § 29.397 must be provided by—

(1) The control stops only;

(2) The control locks only;

(3) The irreversible mechanism only (with the mechanism locked and with the control surface in the critical positions for the effective parts of the system within its limit of motion);

(4) The attachment of the control system to the rotor blade pitch control horn only (with the control in the critical positions for the affected parts of the system within the limits of its motion); and

(5) The attachment of the control system to the control surface horn (with the control in the critical positions for the affected parts of the system within the limits of its motion).

(b) Each primary control system, including its supporting structure, must be designed as follows:

(1) The system must withstand loads resulting from the limit pilot forces prescribed in § 29.397;

(2) Notwithstanding paragraph (b)(3) of this section, when power-operated actuator controls or power boost controls are used, the system must also withstand the loads resulting from the limit pilot forces prescribed in § 29.397 in conjunction with the forces output of each normally energized power device, including any single power boost or actuator system failure;

(3) If the system design or the normal operating loads are such that a part of the system cannot react to the limit pilot forces prescribed in § 29.397, that part of the system must be designed to withstand the maximum loads that can be obtained in normal operation. The minimum design loads must, in any

case, provide a rugged system for service use, including consideration of fatigue, jamming, ground gusts, control inertia, and friction loads. In the absence of a rational analysis, the design loads resulting from 0.60 of the specified limit pilot forces are acceptable minimum design loads; and

(4) If operational loads may be exceeded through jamming, ground gusts, control inertia, or friction, the system must withstand the limit pilot forces specified in § 29.397, without yielding.

[Doc. No. 5084, 29 FR 16150, Dec. 3, 1964, as amended by Amdt. 29-26, 55 FR 8002, Mar. 6, 1990]

#### § 29.397 Limit pilot forces and torques.

(a) Except as provided in paragraph (b) of this section, the limit pilot forces are as follows:

(1) For foot controls, 130 pounds.

(2) For stick controls, 100 pounds fore and aft, and 67 pounds laterally.

(b) For flap, tab, stabilizer, rotor brake, and landing gear operating controls, the following apply (R=radius in inches):

(1) Crank wheel, and lever controls,  $[1 + R]/3 \times 50$  pounds, but not less than 50 pounds nor more than 100 pounds for hand operated controls or 130 pounds for foot operated controls, applied at any angle within 20 degrees of the plane of motion of the control.

(2) Twist controls, 80R inch-pounds.

[Amdt. 29-12, 41 FR 55471, Dec. 20, 1976, as amended by Amdt. 29-47, 66 FR 23538, May 9, 2001]

#### § 29.399 Dual control system.

Each dual primary flight control system must be able to withstand the loads that result when pilot forces not less than 0.75 times those obtained under § 29.395 are applied—

(a) In opposition; and

(b) In the same direction.

#### § 29.411 Ground clearance: tail rotor guard.

(a) It must be impossible for the tail rotor to contact the landing surface during a normal landing.

(b) If a tail rotor guard is required to show compliance with paragraph (a) of this section—

(1) Suitable design loads must be established for the guard; and

(2) The guard and its supporting structure must be designed to withstand those loads.

#### § 29.427 Unsymmetrical loads.

(a) Horizontal tail surfaces and their supporting structure must be designed for unsymmetrical loads arising from yawing and rotor wake effects in combination with the prescribed flight conditions.

(b) To meet the design criteria of paragraph (a) of this section, in the absence of more rational data, both of the following must be met:

(1) One hundred percent of the maximum loading from the symmetrical flight conditions acts on the surface on one side of the plane of symmetry, and no loading acts on the other side.

(2) Fifty percent of the maximum loading from the symmetrical flight conditions acts on the surface on each side of the plane of symmetry, in opposite directions.

(c) For empennage arrangements where the horizontal tail surfaces are supported by the vertical tail surfaces, the vertical tail surfaces and supporting structure must be designed for the combined vertical and horizontal surface loads resulting from each prescribed flight condition, considered separately. The flight conditions must be selected so that the maximum design loads are obtained on each surface. In the absence of more rational data, the unsymmetrical horizontal tail surface loading distributions described in this section must be assumed.

[Amdt. 27-26, 55 FR 8002, Mar. 6, 1990, as amended by Amdt. 29-31, 55 FR 38966, Sept. 21, 1990]

### GROUND LOADS

#### § 29.471 General.

(a) *Loads and equilibrium.* For limit ground loads—

(1) The limit ground loads obtained in the landing conditions in this part must be considered to be external loads that would occur in the rotorcraft structure if it were acting as a rigid body; and

(2) In each specified landing condition, the external loads must be placed in equilibrium with linear and angular