

adjacent fixed structure, when one surface is held in its most critical clearance positions and the others are operated through their full movement.

(b) If an adjustable stabilizer is used, it must have stops that will limit its range of travel to that allowing safe flight and landing.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-45, 58 FR 42164, Aug. 6, 1993]

§ 23.657 Hinges.

(a) Control surface hinges, except ball and roller bearing hinges, must have a factor of safety of not less than 6.67 with respect to the ultimate bearing strength of the softest material used as a bearing.

(b) For ball or roller bearing hinges, the approved rating of the bearing may not be exceeded.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-48, 61 FR 5148, Feb. 9, 1996]

§ 23.659 Mass balance.

The supporting structure and the attachment of concentrated mass balance weights used on control surfaces must be designed for—

(a) 24 *g* normal to the plane of the control surface;

(b) 12 *g* fore and aft; and

(c) 12 *g* parallel to the hinge line.

CONTROL SYSTEMS

§ 23.671 General.

(a) Each control must operate easily, smoothly, and positively enough to allow proper performance of its functions.

(b) Controls must be arranged and identified to provide for convenience in operation and to prevent the possibility of confusion and subsequent inadvertent operation.

§ 23.672 Stability augmentation and automatic and power-operated systems.

If the functioning of stability augmentation or other automatic or power-operated systems is necessary to show compliance with the flight characteristics requirements of this part, such systems must comply with § 23.671 and the following:

(a) A warning, which is clearly distinguishable to the pilot under expected flight conditions without requiring the pilot's attention, must be provided for any failure in the stability augmentation system or in any other automatic or power-operated system that could result in an unsafe condition if the pilot was not aware of the failure. Warning systems must not activate the control system.

(b) The design of the stability augmentation system or of any other automatic or power-operated system must permit initial counteraction of failures without requiring exceptional pilot skill or strength, by either the deactivation of the system or a failed portion thereof, or by overriding the failure by movement of the flight controls in the normal sense.

(c) It must be shown that, after any single failure of the stability augmentation system or any other automatic or power-operated system—

(1) The airplane is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations that is critical for the type of failure being considered;

(2) The controllability and maneuverability requirements of this part are met within a practical operational flight envelope (for example, speed, altitude, normal acceleration, and airplane configuration) that is described in the Airplane Flight Manual (AFM); and

(3) The trim, stability, and stall characteristics are not impaired below a level needed to permit continued safe flight and landing.

[Doc. No. 26269, 58 FR 42164, Aug. 6, 1993]

§ 23.673 Primary flight controls.

Primary flight controls are those used by the pilot for the immediate control of pitch, roll, and yaw.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-48, 61 FR 5148, Feb. 9, 1996]

§ 23.675 Stops.

(a) Each control system must have stops that positively limit the range of motion of each movable aerodynamic surface controlled by the system.

§ 23.677

(b) Each stop must be located so that wear, slackness, or takeup adjustments will not adversely affect the control characteristics of the airplane because of a change in the range of surface travel.

(c) Each stop must be able to withstand any loads corresponding to the design conditions for the control system.

[Amdt. 23-17, 41 FR 55464, Dec. 20, 1976]

§ 23.677 Trim systems.

(a) Proper precautions must be taken to prevent inadvertent, improper, or abrupt trim tab operation. There must be means near the trim control to indicate to the pilot the direction of trim control movement relative to airplane motion. In addition, there must be means to indicate to the pilot the position of the trim device with respect to both the range of adjustment and, in the case of lateral and directional trim, the neutral position. This means must be visible to the pilot and must be located and designed to prevent confusion. The pitch trim indicator must be clearly marked with a position or range within which it has been demonstrated that take-off is safe for all center of gravity positions and each flap position approved for takeoff.

(b) Trimming devices must be designed so that, when any one connecting or transmitting element in the primary flight control system fails, adequate control for safe flight and landing is available with—

(1) For single-engine airplanes, the longitudinal trimming devices; or

(2) For multiengine airplanes, the longitudinal and directional trimming devices.

(c) Tab controls must be irreversible unless the tab is properly balanced and has no unsafe flutter characteristics. Irreversible tab systems must have adequate rigidity and reliability in the portion of the system from the tab to the attachment of the irreversible unit to the airplane structure.

(d) It must be demonstrated that the airplane is safely controllable and that the pilot can perform all maneuvers and operations necessary to effect a safe landing following any probable powered trim system runaway that reasonably might be expected in serv-

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ice, allowing for appropriate time delay after pilot recognition of the trim system runaway. The demonstration must be conducted at critical airplane weights and center of gravity positions.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-7, 34 FR 13091, Aug. 13, 1969; Amdt. 23-34, 52 FR 1830, Jan. 15, 1987; Amdt. 23-42, 56 FR 353, Jan. 3, 1991; Amdt. 23-49, 61 FR 5165, Feb. 9, 1996]

§ 23.679 Control system locks.

If there is a device to lock the control system on the ground or water:

(a) There must be a means to—

(1) Give unmistakable warning to the pilot when lock is engaged; or

(2) Automatically disengage the device when the pilot operates the primary flight controls in a normal manner.

(b) The device must be installed to limit the operation of the airplane so that, when the device is engaged, the pilot receives unmistakable warning at the start of the takeoff.

(c) The device must have a means to preclude the possibility of it becoming inadvertently engaged in flight.

[Doc. No. 26269, 58 FR 42164, Aug. 6, 1993]

§ 23.681 Limit load static tests.

(a) Compliance with the limit load requirements of this part must be shown by tests in which—

(1) The direction of the test loads produces the most severe loading in the control system; and

(2) Each fitting, pulley, and bracket used in attaching the system to the main structure is included.

(b) Compliance must be shown (by analyses or individual load tests) with the special factor requirements for control system joints subject to angular motion.

§ 23.683 Operation tests.

(a) It must be shown by operation tests that, when the controls are operated from the pilot compartment with the system loaded as prescribed in paragraph (b) of this section, the system is free from—

(1) Jamming;

(2) Excessive friction; and

(3) Excessive deflection.

(b) The prescribed test loads are—