

§ 23.623

factors and corresponding inspections must meet the following table:

Casting factor	Inspection
2.0 or more	100 percent visual.
Less than 2.0 but more than 1.5.	100 percent visual, and magnetic particle or penetrant or equivalent nondestructive inspection methods.
1.25 through 1.50	100 percent visual, magnetic particle or penetrant, and radiographic, or approved equivalent nondestructive inspection methods.

(2) The percentage of castings inspected by nonvisual methods may be reduced below that specified in subparagraph (d)(1) of this section when an approved quality control procedure is established.

(3) For castings procured to a specification that guarantees the mechanical properties of the material in the casting and provides for demonstration of these properties by test of coupons cut from the castings on a sampling basis—

(i) A casting factor of 1.0 may be used; and

(ii) The castings must be inspected as provided in paragraph (d)(1) of this section for casting factors of “1.25 through 1.50” and tested under paragraph (c)(2) of this section.

(e) *Non-structural castings.* Castings used for non-structural purposes do not require evaluation, testing or close inspection.

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

§ 23.623 Bearing factors.

(a) Each part that has clearance (free fit), and that is subject to pounding or vibration, must have a bearing factor large enough to provide for the effects of normal relative motion.

(b) For control surface hinges and control system joints, compliance with the factors prescribed in §§ 23.657 and 23.693, respectively, meets paragraph (a) of this section.

[Amdt. 23-7, 34 FR 13091, Aug. 13, 1969]

§ 23.625 Fitting factors.

For each fitting (a part or terminal used to join one structural member to another), the following apply:

(a) For each fitting whose strength is not proven by limit and ultimate load tests in which actual stress conditions are simulated in the fitting and surrounding structures, a fitting factor of at least 1.15 must be applied to each part of—

- (1) The fitting;
- (2) The means of attachment; and
- (3) The bearing on the joined members.

(b) No fitting factor need be used for joint designs based on comprehensive test data (such as continuous joints in metal plating, welded joints, and scarf joints in wood).

(c) For each integral fitting, the part must be treated as a fitting up to the point at which the section properties become typical of the member.

(d) For each seat, berth, safety belt, and harness, its attachment to the structure must be shown, by analysis, tests, or both, to be able to withstand the inertia forces prescribed in § 23.561 multiplied by a fitting factor of 1.33.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-7, 34 FR 13091, Aug. 13, 1969]

§ 23.627 Fatigue strength.

The structure must be designed, as far as practicable, to avoid points of stress concentration where variable stresses above the fatigue limit are likely to occur in normal service.

§ 23.629 Flutter.

(a) It must be shown by the methods of paragraph (b) and either paragraph (c) or (d) of this section, that the airplane is free from flutter, control reversal, and divergence for any condition of operation within the limit V-n envelope and at all speeds up to the speed specified for the selected method. In addition—

(1) Adequate tolerances must be established for quantities which affect flutter, including speed, damping, mass balance, and control system stiffness; and

(2) The natural frequencies of main structural components must be determined by vibration tests or other approved methods.

(b) Flight flutter tests must be made to show that the airplane is free from

flutter, control reversal and divergence and to show that—

(1) Proper and adequate attempts to induce flutter have been made within the speed range up to V_D ;

(2) The vibratory response of the structure during the test indicates freedom from flutter;

(3) A proper margin of damping exists at V_D ; and

(4) There is no large and rapid reduction in damping as V_D is approached.

(c) Any rational analysis used to predict freedom from flutter, control reversal and divergence must cover all speeds up to $1.2 V_D$.

(d) Compliance with the rigidity and mass balance criteria (pages 4-12), in Airframe and Equipment Engineering Report No. 45 (as corrected) "Simplified Flutter Prevention Criteria" (published by the Federal Aviation Administration) may be accomplished to show that the airplane is free from flutter, control reversal, or divergence if—

(1) V_D/M_D for the airplane is less than 260 knots (EAS) and less than Mach 0.5,

(2) The wing and aileron flutter prevention criteria, as represented by the wing torsional stiffness and aileron balance criteria, are limited in use to airplanes without large mass concentrations (such as engines, floats, or fuel tanks in outer wing panels) along the wing span, and

(3) The airplane—

(i) Does not have a T-tail or other unconventional tail configurations;

(ii) Does not have unusual mass distributions or other unconventional design features that affect the applicability of the criteria, and

(iii) Has fixed-fin and fixed-stabilizer surfaces.

(e) For turbopropeller-powered airplanes, the dynamic evaluation must include—

(1) Whirl mode degree of freedom which takes into account the stability of the plane of rotation of the propeller and significant elastic, inertial, and aerodynamic forces, and

(2) Propeller, engine, engine mount, and airplane structure stiffness and damping variations appropriate to the particular configuration.

(f) Freedom from flutter, control reversal, and divergence up to V_D/M_D must be shown as follows:

(1) For airplanes that meet the criteria of paragraphs (d)(1) through (d)(3) of this section, after the failure, malfunction, or disconnection of any single element in any tab control system.

(2) For airplanes other than those described in paragraph (f)(1) of this section, after the failure, malfunction, or disconnection of any single element in the primary flight control system, any tab control system, or any flutter damper.

(g) For airplanes showing compliance with the fail-safe criteria of §§ 23.571 and 23.572, the airplane must be shown by analysis to be free from flutter up to V_D/M_D after fatigue failure, or obvious partial failure, of a principal structural element.

(h) For airplanes showing compliance with the damage tolerance criteria of § 23.573, the airplane must be shown by analysis to be free from flutter up to V_D/M_D with the extent of damage for which residual strength is demonstrated.

(i) For modifications to the type design that could affect the flutter characteristics, compliance with paragraph (a) of this section must be shown, except that analysis based on previously approved data may be used alone to show freedom from flutter, control reversal and divergence, for all speeds up to the speed specified for the selected method.

[Amdt. 23-23, 43 FR 50592, Oct. 30, 1978, as amended by Amdt. 23-31, 49 FR 46867, Nov. 28, 1984; Amdt. 23-45, 58 FR 42164, Aug. 6, 1993; 58 FR 51970, Oct. 5, 1993; Amdt. 23-48, 61 FR 5148, Feb. 9, 1996]

WINGS

§ 23.641 Proof of strength.

The strength of stressed-skin wings must be proven by load tests or by combined structural analysis and load tests.