

**§ 23.619**

(d) The design of the structure must minimize the probability of catastrophic fatigue failure, particularly at points of stress concentration.

(e) Design values greater than the guaranteed minimums required by this section may be used where only guaranteed minimum values are normally allowed if a "premium selection" of the material is made in which a specimen of each individual item is tested before use to determine that the actual strength properties of that particular item will equal or exceed those used in design.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964; 30 FR 258, Jan. 9, 1965, as amended by Amdt. 23-23, 43 FR 50592, Oct. 30, 1978; Amdt. 23-45, 58 FR 42163, Aug. 6, 1993]

**§ 23.619 Special factors.**

The factor of safety prescribed in § 23.303 must be multiplied by the highest pertinent special factors of safety prescribed in §§ 23.621 through 23.625 for each part of the structure whose strength is—

- (a) Uncertain;
- (b) Likely to deteriorate in service before normal replacement; or
- (c) Subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods.

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

**§ 23.621 Casting factors.**

(a) *General.* The factors, tests, and inspections specified in paragraphs (b) through (d) of this section must be applied in addition to those necessary to establish foundry quality control. The inspections must meet approved specifications. Paragraphs (c) and (d) of this section apply to any structural castings except castings that are pressure tested as parts of hydraulic or other fluid systems and do not support structural loads.

(b) *Bearing stresses and surfaces.* The casting factors specified in paragraphs (c) and (d) of this section—

(1) Need not exceed 1.25 with respect to bearing stresses regardless of the method of inspection used; and

(2) Need not be used with respect to the bearing surfaces of a part whose bearing factor is larger than the applicable casting factor.

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(c) *Critical castings.* For each casting whose failure would preclude continued safe flight and landing of the airplane or result in serious injury to occupants, the following apply:

(1) Each critical casting must either—

(i) Have a casting factor of not less than 1.25 and receive 100 percent inspection by visual, radiographic, and either magnetic particle, penetrant or other approved equivalent non-destructive inspection method; or

(ii) Have a casting factor of not less than 2.0 and receive 100 percent visual inspection and 100 percent approved non-destructive inspection. When an approved quality control procedure is established and an acceptable statistical analysis supports reduction, non-destructive inspection may be reduced from 100 percent, and applied on a sampling basis.

(2) For each critical casting with a casting factor less than 1.50, three sample castings must be static tested and shown to meet—

(i) The strength requirements of § 23.305 at an ultimate load corresponding to a casting factor of 1.25; and

(ii) The deformation requirements of § 23.305 at a load of 1.15 times the limit load.

(3) Examples of these castings are structural attachment fittings, parts of flight control systems, control surface hinges and balance weight attachments, seat, berth, safety belt, and fuel and oil tank supports and attachments, and cabin pressure valves.

(d) *Non-critical castings.* For each casting other than those specified in paragraph (c) or (e) of this section, the following apply:

(1) Except as provided in paragraphs (d)(2) and (3) of this section, the casting 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.