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]

EFFECTIVE DATE NOTE: By Amdt. 23–62, 76 FR 75756, Dec. 2, 2011, § 23.629 was amended by revising paragraphs (b)(1), (b)(3), (b)(4), and (c), effective Jan. 31, 2012. For the convenience of the user, the revised text is set forth as follows:

§ 23.629 Flutter.

* * * * *

(b) * * *

(1) Proper and adequate attempts to induce flutter have been made within the speed range up to V_D/M_D, or V_{DF}/M_{DF} for jets;

* * * * *

(3) A proper margin of damping exists at V_D/M_D, or V_{DF}/M_{DF} for jets; and

(4) As V_D/M_D (or V_{DF}/M_{DF} for jets) is approached, there is no large or rapid reduction in damping.

(c) Any rational analysis used to predict freedom from flutter, control reversal and divergence must cover all speeds up to 1.2 V_D/1.2 M_D, limited to Mach 1.0 for subsonic airplanes.

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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.

CONTROL SURFACES

§ 23.651 Proof of strength.

(a) Limit load tests of control surfaces are required. These tests must include the horn or fitting to which the control system is attached.

(b) In structural analyses, rigging loads due to wire bracing must be accounted for in a rational or conservative manner.