

that it may be subjected to in operation.

(b) Each flexible fuel tank liner must be shown to be suitable for the particular application.

(c) Each integral fuel tank must have adequate facilities for interior inspection and repair.

(d) The total usable capacity of the fuel tanks must be enough for at least one-half hour of operation at maximum continuous power.

(e) Each fuel quantity indicator must be adjusted, as specified in §23.1337(b), to account for the unusable fuel supply determined under §23.959(a).

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964; 30 FR 258, Jan. 9, 1965, as amended by Amdt. 23-34, 52 FR 1832, Jan. 15, 1987; Amdt. 23-43, 58 FR 18972, Apr. 9, 1993; Amdt. 23-51, 61 FR 5136, Feb. 9, 1996]

#### § 23.965 Fuel tank tests.

(a) Each fuel tank must be able to withstand the following pressures without failure or leakage:

(1) For each conventional metal tank and nonmetallic tank with walls not supported by the airplane structure, a pressure of 3.5 p.s.i., or that pressure developed during maximum ultimate acceleration with a full tank, whichever is greater.

(2) For each integral tank, the pressure developed during the maximum limit acceleration of the airplane with a full tank, with simultaneous application of the critical limit structural loads.

(3) For each nonmetallic tank with walls supported by the airplane structure and constructed in an acceptable manner using acceptable basic tank material, and with actual or simulated support conditions, a pressure of 2 p.s.i. for the first tank of a specific design. The supporting structure must be designed for the critical loads occurring in the flight or landing strength conditions combined with the fuel pressure loads resulting from the corresponding accelerations.

(b) Each fuel tank with large, unsupported, or unstiffened flat surfaces, whose failure or deformation could cause fuel leakage, must be able to withstand the following test without leakage, failure, or excessive deformation of the tank walls:

(1) Each complete tank assembly and its support must be vibration tested while mounted to simulate the actual installation.

(2) Except as specified in paragraph (b)(4) of this section, the tank assembly must be vibrated for 25 hours at a total displacement of not less than  $\frac{1}{32}$  of an inch (unless another displacement is substantiated) while  $\frac{2}{3}$  filled with water or other suitable test fluid.

(3) The test frequency of vibration must be as follows:

(i) If no frequency of vibration resulting from any rpm within the normal operating range of engine or propeller speeds is critical, the test frequency of vibration is:

(A) The number of cycles per minute obtained by multiplying the maximum continuous propeller speed in rpm by 0.9 for propeller-driven airplanes, and

(B) For non-propeller driven airplanes the test frequency of vibration is 2,000 cycles per minute.

(ii) If only one frequency of vibration resulting from any rpm within the normal operating range of engine or propeller speeds is critical, that frequency of vibration must be the test frequency.

(iii) If more than one frequency of vibration resulting from any rpm within the normal operating range of engine or propeller speeds is critical, the most critical of these frequencies must be the test frequency.

(4) Under paragraph (b)(3) (ii) and (iii) of this section, the time of test must be adjusted to accomplish the same number of vibration cycles that would be accomplished in 25 hours at the frequency specified in paragraph (b)(3)(i) of this section.

(5) During the test, the tank assembly must be rocked at a rate of 16 to 20 complete cycles per minute, through an angle of 15° on either side of the horizontal (30° total), about an axis parallel to the axis of the fuselage, for 25 hours.

(c) Each integral tank using methods of construction and sealing not previously proven to be adequate by test data or service experience must be able to withstand the vibration test specified in paragraphs (b)(1) through (4) of this section.

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(d) Each tank with a nonmetallic liner must be subjected to the sloshing test outlined in paragraph (b)(5) of this section, with the fuel at room temperature. In addition, a specimen liner of the same basic construction as that to be used in the airplane must, when installed in a suitable test tank, withstand the sloshing test with fuel at a temperature of 110 °F.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23–43, 58 FR 18972, Apr. 9, 1993; Amdt. 23–43, 61 FR 253, Jan. 4, 1996; Amdt. 23–51, 61 FR 5136, Feb. 9, 1996]

### § 23.967 Fuel tank installation.

(a) Each fuel tank must be supported so that tank loads are not concentrated. In addition—

(1) There must be pads, if necessary, to prevent chafing between each tank and its supports;

(2) Padding must be nonabsorbent or treated to prevent the absorption of fuel;

(3) If a flexible tank liner is used, it must be supported so that it is not required to withstand fluid loads;

(4) Interior surfaces adjacent to the liner must be smooth and free from projections that could cause wear, unless—

(i) Provisions are made for protection of the liner at those points; or

(ii) The construction of the liner itself provides such protection; and

(5) A positive pressure must be maintained within the vapor space of each bladder cell under any condition of operation, except for a particular condition for which it is shown that a zero or negative pressure will not cause the bladder cell to collapse; and

(6) Syphoning of fuel (other than minor spillage) or collapse of bladder fuel cells may not result from improper securing or loss of the fuel filler cap.

(b) Each tank compartment must be ventilated and drained to prevent the accumulation of flammable fluids or vapors. Each compartment adjacent to a tank that is an integral part of the airplane structure must also be ventilated and drained.

(c) No fuel tank may be on the engine side of the firewall. There must be at least one-half inch of clearance between the fuel tank and the firewall. No part of the engine nacelle skin that

lies immediately behind a major air opening from the engine compartment may act as the wall of an integral tank.

(d) Each fuel tank must be isolated from personnel compartments by a fume-proof and fuel-proof enclosure that is vented and drained to the exterior of the airplane. The required enclosure must sustain any personnel compartment pressurization loads without permanent deformation or failure under the conditions of §§ 23.365 and 23.843 of this part. A bladder-type fuel cell, if used, must have a retaining shell at least equivalent to a metal fuel tank in structural integrity.

(e) Fuel tanks must be designed, located, and installed so as to retain fuel:

(1) When subjected to the inertia loads resulting from the ultimate static load factors prescribed in § 23.561(b)(2) of this part; and

(2) Under conditions likely to occur when the airplane lands on a paved runway at a normal landing speed under each of the following conditions:

(i) The airplane in a normal landing attitude and its landing gear retracted.

(ii) The most critical landing gear leg collapsed and the other landing gear legs extended.

In showing compliance with paragraph (e)(2) of this section, the tearing away of an engine mount must be considered unless all the engines are installed above the wing or on the tail or fuselage of the airplane.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23–7, 34 FR 13903, Aug. 13, 1969; Amdt. 23–14, 38 FR 31823, Nov. 19, 1973; Amdt. 23–18, 42 FR 15041, Mar. 17, 1977; Amdt. 23–26, 45 FR 60171, Sept. 11, 1980; Amdt. 23–36, 53 FR 30815, Aug. 15, 1988; Amdt. 23–43, 58 FR 18972, Apr. 9, 1993]

### § 23.969 Fuel tank expansion space.

Each fuel tank must have an expansion space of not less than two percent of the tank capacity, unless the tank vent discharges clear of the airplane (in which case no expansion space is required). It must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude.