

§ 23.954

(3) Filler caps designed to minimize the probability of incorrect installation or inflight loss.

(4) A fuel system in which those parts of the system from each tank outlet to any engine are independent of each part of the system supplying fuel to any other engine.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-7, 34 FR 13093 Aug. 13, 1969; Amdt. 23-43, 58 FR 18971, Apr. 9, 1993]

§ 23.954 Fuel system lightning protection.

The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by—

(a) Direct lightning strikes to areas having a high probability of stroke attachment;

(b) Swept lightning strokes on areas where swept strokes are highly probable; and

(c) Corona or streamering at fuel vent outlets.

[Amdt. 23-7, 34 FR 13093, Aug. 13, 1969]

§ 23.955 Fuel flow.

(a) *General.* The ability of the fuel system to provide fuel at the rates specified in this section and at a pressure sufficient for proper engine operation must be shown in the attitude that is most critical with respect to fuel feed and quantity of unusable fuel. These conditions may be simulated in a suitable mockup. In addition—

(1) The quantity of fuel in the tank may not exceed the amount established as the unusable fuel supply for that tank under §23.959(a) plus that quantity necessary to show compliance with this section.

(2) If there is a fuel flowmeter, it must be blocked during the flow test and the fuel must flow through the meter or its bypass.

(3) If there is a flowmeter without a bypass, it must not have any probable failure mode that would restrict fuel flow below the level required for this fuel demonstration.

(4) The fuel flow must include that flow necessary for vapor return flow, jet pump drive flow, and for all other purposes for which fuel is used.

(b) *Gravity systems.* The fuel flow rate for gravity systems (main and reserve

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supply) must be 150 percent of the takeoff fuel consumption of the engine.

(c) *Pump systems.* The fuel flow rate for each pump system (main and reserve supply) for each reciprocating engine must be 125 percent of the fuel flow required by the engine at the maximum takeoff power approved under this part.

(1) This flow rate is required for each main pump and each emergency pump, and must be available when the pump is operating as it would during takeoff;

(2) For each hand-operated pump, this rate must occur at not more than 60 complete cycles (120 single strokes) per minute.

(3) The fuel pressure, with main and emergency pumps operating simultaneously, must not exceed the fuel inlet pressure limits of the engine unless it can be shown that no adverse effect occurs.

(d) *Auxiliary fuel systems and fuel transfer systems.* Paragraphs (b), (c), and (f) of this section apply to each auxiliary and transfer system, except that—

(1) The required fuel flow rate must be established upon the basis of maximum continuous power and engine rotational speed, instead of takeoff power and fuel consumption; and

(2) If there is a placard providing operating instructions, a lesser flow rate may be used for transferring fuel from any auxiliary tank into a larger main tank. This lesser flow rate must be adequate to maintain engine maximum continuous power but the flow rate must not overflow the main tank at lower engine powers.

(e) *Multiple fuel tanks.* For reciprocating engines that are supplied with fuel from more than one tank, if engine power loss becomes apparent due to fuel depletion from the tank selected, it must be possible after switching to any full tank, in level flight, to obtain 75 percent maximum continuous power on that engine in not more than—

(1) 10 seconds for naturally aspirated single-engine airplanes;

(2) 20 seconds for turbocharged single-engine airplanes, provided that 75 percent maximum continuous naturally aspirated power is regained within 10 seconds; or

(3) 20 seconds for multiengine airplanes.

(f) *Turbine engine fuel systems.* Each turbine engine fuel system must provide at least 100 percent of the fuel flow required by the engine under each intended operation condition and maneuver. The conditions may be simulated in a suitable mockup. This flow must—

(1) Be shown with the airplane in the most adverse fuel feed condition (with respect to altitudes, attitudes, and other conditions) that is expected in operation; and

(2) For multiengine airplanes, notwithstanding the lower flow rate allowed by paragraph (d) of this section, be automatically uninterrupted with respect to any engine until all the fuel scheduled for use by that engine has been consumed. In addition—

(i) For the purposes of this section, “fuel scheduled for use by that engine” means all fuel in any tank intended for use by a specific engine.

(ii) The fuel system design must clearly indicate the engine for which fuel in any tank is scheduled.

(iii) Compliance with this paragraph must require no pilot action after completion of the engine starting phase of operations.

(3) For single-engine airplanes, require no pilot action after completion of the engine starting phase of operations unless means are provided that unmistakably alert the pilot to take any needed action at least five minutes prior to the needed action; such pilot action must not cause any change in engine operation; and such pilot action must not distract pilot attention from essential flight duties during any phase of operations for which the airplane is approved.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-7, 34 FR 13093, Aug. 13, 1969; Amdt. 23-43, 58 FR 18971, Apr. 9, 1993; Amdt. 23-51, 61 FR 5136, Feb. 9, 1996]

§ 23.957 Flow between interconnected tanks.

(a) It must be impossible, in a gravity feed system with interconnected tank outlets, for enough fuel to flow between the tanks to cause an overflow of fuel from any tank vent under the conditions in § 23.959, except that full tanks must be used.

(b) If fuel can be pumped from one tank to another in flight, the fuel tank

vents and the fuel transfer system must be designed so that no structural damage to any airplane component can occur because of overfilling of any tank.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-43, 58 FR 18972, Apr. 9, 1993]

§ 23.959 Unusable fuel supply.

(a) The unusable fuel supply for each tank must be established as not less than that quantity at which the first evidence of malfunctioning occurs under the most adverse fuel feed condition occurring under each intended operation and flight maneuver involving that tank. Fuel system component failures need not be considered.

(b) The effect on the usable fuel quantity as a result of a failure of any pump shall be determined.

[Amdt. 23-7, 34 FR 13093, Aug. 13, 1969, as amended by Amdt. 23-18, 42 FR 15041, Mar. 17, 1977; Amdt. 23-51, 61 FR 5136, Feb. 9, 1996]

§ 23.961 Fuel system hot weather operation.

Each fuel system must be free from vapor lock when using fuel at its critical temperature, with respect to vapor formation, when operating the airplane in all critical operating and environmental conditions for which approval is requested. For turbine fuel, the initial temperature must be 110 °F, -0°, +5 °F or the maximum outside air temperature for which approval is requested, whichever is more critical.

[Doc. No. 26344, 58 FR 18972, Apr. 9, 1993; 58 FR 27060, May 6, 1993]

§ 23.963 Fuel tanks: General.

(a) Each fuel tank must be able to withstand, without failure, the vibration, inertia, fluid, and structural loads 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.