

## § 29.957

required to operate the engines under the test conditions required by § 29.927. Unless equivalent methods are used, compliance must be shown by test during which the following provisions are met, except that combinations of conditions which are shown to be improbable need not be considered.

(1) The fuel pressure, corrected for accelerations (load factors), must be within the limits specified by the engine type certificate data sheet.

(2) The fuel level in the tank may not exceed that established as the unusable fuel supply for that tank under § 29.959, plus that necessary to conduct the test.

(3) The fuel head between the tank and the engine must be critical with respect to rotorcraft flight attitudes.

(4) The fuel flow transmitter, if installed, and the critical fuel pump (for pump-fed systems) must be installed to produce (by actual or simulated failure) the critical restriction to fuel flow to be expected from component failure.

(5) Critical values of engine rotational speed, electrical power, or other sources of fuel pump motive power must be applied.

(6) Critical values of fuel properties which adversely affect fuel flow are applied during demonstrations of fuel flow capability.

(7) The fuel filter required by § 29.997 is blocked to the degree necessary to simulate the accumulation of fuel contamination required to activate the indicator required by § 29.1305(a)(17).

(b) *Fuel transfer system.* If normal operation of the fuel system requires fuel to be transferred to another tank, the transfer must occur automatically via a system which has been shown to maintain the fuel level in the receiving tank within acceptable limits during flight or surface operation of the rotorcraft.

(c) *Multiple fuel tanks.* If an engine can be supplied with fuel from more than one tank, the fuel system, in addition to having appropriate manual switching capability, must be designed to prevent interruption of fuel flow to that engine, without attention by the flightcrew, when any tank supplying fuel to that engine is depleted of usable fuel during normal operation and any other tank that normally supplies fuel

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to that engine alone contains usable fuel.

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### § 29.957 Flow between interconnected tanks.

(a) Where tank outlets are interconnected and allow fuel to flow between them due to gravity or flight accelerations, it must be impossible for fuel to flow between tanks in quantities great enough to cause overflow from the tank vent in any sustained flight condition.

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

(1) The design of the vents and the fuel transfer system must prevent structural damage to tanks from overfilling; and

(2) There must be means to warn the crew before overflow through the vents occurs.

### § 29.959 Unusable fuel supply.

The unusable fuel supply for each tank must be established as not less than the quantity at which the first evidence of malfunction occurs under the most adverse fuel feed condition occurring under any intended operations and flight maneuvers involving that tank.

### § 29.961 Fuel system hot weather operation.

Each suction lift fuel system and other fuel systems conducive to vapor formation must be shown to operate satisfactorily (within certification limits) when using fuel at the most critical temperature for vapor formation under critical operating conditions including, if applicable, the engine operating conditions defined by § 29.927(b)(1) and (b)(2).

[Amdt. 29-26, 53 FR 34217, Sept. 2, 1988]

### § 29.963 Fuel tanks: general.

(a) Each fuel tank must be able to withstand, without failure, the vibration, inertia, fluid, and structural loads to which it may be subjected in operation.

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

and must be puncture resistant. Puncture resistance must be shown by meeting the TSO-C80, paragraph 16.0, requirements using a minimum puncture force of 370 pounds.

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

(d) The maximum exposed surface temperature of all components in the fuel tank must be less by a safe margin than the lowest expected autoignition temperature of the fuel or fuel vapor in the tank. Compliance with this requirement must be shown under all operating conditions and under all normal or malfunction conditions of all components inside the tank.

(e) Each fuel tank installed in personnel compartments must be isolated by fume-proof and fuel-proof enclosures that are drained and vented to the exterior of the rotorcraft. The design and construction of the enclosures must provide necessary protection for the tank, must be crash resistant during a survivable impact in accordance with § 29.952, and must be adequate to withstand loads and abrasions to be expected in personnel compartments.

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#### § 29.965 Fuel tank tests.

(a) Each fuel tank must be able to withstand the applicable pressure tests in this section without failure or leakage. If practicable, test pressures may be applied in a manner simulating the pressure distribution in service.

(b) Each conventional metal tank, each nonmetallic tank with walls that are not supported by the rotorcraft structure, and each integral tank must be subjected to a pressure of 3.5 p.s.i. unless the pressure developed during maximum limit acceleration or emergency deceleration with a full tank exceeds this value, in which case a hydrostatic head, or equivalent test, must be applied to duplicate the acceleration loads as far as possible. However, the pressure need not exceed 3.5 p.s.i. on surfaces not exposed to the acceleration loading.

(c) Each nonmetallic tank with walls supported by the rotorcraft structure

must be subjected to the following tests:

(1) A pressure test of at least 2.0 p.s.i. This test may be conducted on the tank alone in conjunction with the test specified in paragraph (c)(2) of this section.

(2) A pressure test, with the tank mounted in the rotorcraft structure, equal to the load developed by the reaction of the contents, with the tank full, during maximum limit acceleration or emergency deceleration. However, the pressure need not exceed 2.0 p.s.i. on surfaces faces not exposed to the acceleration loading.

(d) Each tank with large unsupported or unstiffened flat areas, or with other features whose failure or deformation could cause leakage, must be subjected to the following test or its equivalent:

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

(2) The tank assembly must be vibrated for 25 hours while two-thirds full of any suitable fluid. The amplitude of vibration may not be less than one thirty-second of an inch, unless otherwise substantiated.

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

(i) If no frequency of vibration resulting from any r.p.m. within the normal operating range of engine or rotor system speeds is critical, the test frequency of vibration, in number of cycles per minute, must, unless a frequency based on a more rational analysis is used, be the number obtained by averaging the maximum and minimum power-on engine speeds (r.p.m.) for reciprocating engine powered rotorcraft or 2,000 c.p.m. for turbine engine powered rotorcraft.

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

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