Designation: ~~F3063/F3063M – 15~~ F3063/F3063M – 16

Standard Specification for Design and Integration of Fuel/Energy Storage and Delivery System Installations for Aeroplanes[1]

This standard is issued under the fixed designation F3063/F3063M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers minimum requirements for the design and integration of Fuel/Energy Storage and Delivery system installations for aeroplanes.

1.2 This specification is applicable to aeroplanes as defined in the F44 terminology standard.

1.3 The applicant for a design approval must seek the individual guidance to their respective CAA body concerning the use of this standard as part of a certification plan. For information on which CAA regulatory bodies have accepted this standard (in whole or in part) as a means of compliance to their Aeroplane Airworthiness regulations (Hereinafter referred to as "the Rules"), refer to ASTM F44 webpage (www.ASTM.org/COMITTEE/F44.htm) which includes CAA website links.

1.4 *Units*—The values stated are SI units followed by imperial units in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F3060 Terminology for Aircraft

F3083/F3083M Specification for Emergency Conditions, Occupant Safety, and Accommodations

F3116/F3116M Specification for Design Loads and Conditions

2.2 *Other Standard:*

US 14 CFR Part 23 Airworthiness Standards: Normal, Utility, Aerobatic and Commuter Category Airplanes (Amendment 62)[3]

3. Terminology

3.1 The following are a selection of relevant terms. See Terminology F3060 for more definitions and abbreviations.

3.2 *Definitions:*

3.2.1 *main pump, n*—a pump that supplies sufficient fuel to sustain the engine during normal operations.

3.2.2 *emergency pump, n*—a pump that can sustain engine operation at full power in the event the main pump fails.

3.2.3 *auxiliary pump, n*—a pump that can provide some fuel flow during emergency operations but not enough to sustain engine operation at full power. Its function is to aid in priming the engine and suppressing fuel vapors.

3.3 *Abbreviations:*

3.3.1 *cc*—cubic ~~centimeter~~centimetre

3.3.2 *CFR*—Code of Federal Regulations

[1] This specification is under the jurisdiction of ASTM Committee F44 on General Aviation Aircraft and is the direct responsibility of Subcommittee F44.40 on Powerplant.

Current edition approved ~~June 1, 2015~~Feb. 1, 2016. Published ~~August 2015~~March 2016. Originally approved in 2015. Last previous edition approved in 2015 as F3063/F3063M – 15. DOI: ~~10.1520/F3063_F3063M-15.~~10.1520/F3063_F3063M-16.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

3.3.3 *RPM*—rotation per minute

4. Fuel System

4.1 *General:*

4.1.1 Each fuel system must be constructed and arranged to ensure fuel flow at a rate and pressure established for proper engine and auxiliary power unit functioning under each likely operating condition, including any maneuver for which certification is requested and during which the engine or auxiliary power unit is permitted to be in operation.

4.1.2 Each fuel system for a turbine engine and compression ignition engine must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 27°C [80°F] and having 0.75 cc of free water per 3.8 L [1 US-gal] added and cooled to the most critical condition for icing likely to be encountered in operation.

4.1.3 Each fuel system for a turbine engine powered aeroplane must meet the applicable fuel venting requirements of 14 CFR part 34 for the US or the applicable fuel venting requirements as contained in the rules specified by the applicant's local civil aviation authority.

4.1.4 Each fuel system must be arranged so that:

4.1.4.1 No fuel pump can draw fuel from more than one tank at a time; or

4.1.4.2 There are means to prevent introducing air into the system.

4.1.5 Fuel system components in an engine nacelle or in the fuselage must be protected from damage which could result in spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway.

4.1.6 Each check valve must be constructed, or otherwise incorporate provisions, to preclude incorrect assembly or connection of the valve.

4.2 *Independence:*

4.2.1 Each fuel system for a multiengine aeroplane must be arranged so that, in at least one system configuration, the failure of any one component will not result in the loss of power of more than one engine or require immediate action by the pilot to prevent the loss of power of more than one engine.

4.2.2 If a single fuel tank (or series of fuel tanks interconnected to function as a single fuel tank) is used on a multiengine aeroplane, the provision of 4.2.2.1 through 4.2.2.3 must be met.

4.2.2.1 For each engine, provisions of 4.2.2.1*(1)* and *(2)* must be met:

(1) Independent tank outlets.

(2) A shut-off valve at each tank outlet. This shutoff valve may also serve as the fire wall shutoff valve required if the line between the valve and the engine compartment does not contain more than 1 L [1 US qt] of fuel (or any greater amount shown to be safe) that can escape into the engine compartment.

4.2.2.2 At least two vents arranged to minimize the probability of both vents becoming obstructed simultaneously must be provided.

4.2.2.3 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 must be provided.

4.3 *Drains:*

4.3.1 There must be at least one drain to allow safe drainage of the entire fuel system with the aeroplane in its normal ground attitude.

4.3.2 Each drain installed for the purposes of draining the entire fuel system or for the purposes of draining hazardous quantities of water must meet the provision of 4.3.2.1 through 4.3.2.2.

4.3.2.1 Discharge clear of all parts of the aeroplane.

4.3.2.2 Have a drain valve that meets 4.3.2.2*(1)* through *(6)*.

(1) That has manual or automatic means for positive locking in the closed position.

(2) That is readily accessible.

(3) That can be easily opened and closed.

(4) That is either located or protected to prevent fuel spillage in the event of a landing with landing gear retracted.

(5) That allows the fuel to be caught for examination.

(6) That can be observed for proper closing.

5. Fuel Tanks

5.1 *General:*

5.1.1 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.

5.1.2 Each flexible fuel tank liner must be shown to be suitable for the particular application.

5.1.3 The total usable capacity of the fuel tanks must be enough for at least 30 min of operation at maximum continuous power.

5.2 *Installation:*

5.2.1 Each fuel tank must be supported so that tank loads are not concentrated.

5.2.1.1 There must be pads, if necessary, to prevent chafing between each tank and its supports.

5.2.1.2 Padding must be nonabsorbent or treated to prevent the absorption of fuel.

5.2.1.3 If a flexible tank liner is used, it must be supported so that it is not required to withstand fluid loads.

5.2.1.4 Interior surfaces adjacent to the liner must be smooth and free from projections that could cause wear, unless provisions are made for protection of the liner at those points; or the construction of the liner itself provides such protection.

5.2.1.5 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.

5.2.1.6 Siphoning 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.

5.2.2 Fuel tanks must be designed, located, and installed so as to retain fuel when subjected to the inertia loads resulting from the ultimate static load factors prescribed in Specification F3083/F3083M; and under conditions likely to occur when the aeroplane lands on a paved runway at a normal landing speed under the conditions specified in 5.2.2.1 through 5.2.2.3.

5.2.2.1 The aeroplane is in a normal landing attitude and its landing gear is retracted.

5.2.2.2 The most critical landing gear leg is collapsed and the other landing gear legs are extended.

5.2.2.3 In showing compliance with 5.2.2.1 and 5.2.2.2, 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 aeroplane.

5.2.3 Each integral fuel tank must have adequate facilities for interior inspection and repair.

5.2.4 For Level 4 aeroplanes, fuel tanks within the fuselage contour must be able to resist rupture and be in a protected position so that exposure of the tanks to scraping action with the ground is unlikely.

5.3 *Compartments:*

5.3.1 Each tank compartment must be ventilated and drained to prevent the accumulation of flammable fluids or vapors.

5.3.2 Each compartment adjacent to a tank that is an integral part of the aeroplane structure must also be ventilated and drained.

5.4 *Expansion Space:*

5.4.1 Each fuel tank must have an expansion space of not less than 2 % of the tank capacity, unless the tank vent discharges clear of the aeroplane (in which case no expansion space is required).

5.4.2 It must be impossible to fill the expansion space inadvertently with the aeroplane in the normal ground attitude.

5.5 *Vents and Carburetor Vapor Vents:*

5.5.1 Each fuel tank must be vented from the top part of the expansion space.

5.5.1.1 Each vent outlet must be located and constructed in a manner that minimizes the possibility of its being obstructed by ice or other foreign matter.

5.5.1.2 Each vent must be constructed to prevent siphoning of fuel during normal operation.

5.5.1.3 The venting capacity must allow the rapid relief of excessive differences of pressure between the interior and exterior of the tank.

5.5.1.4 Airspaces of tanks with interconnected outlets must be interconnected.

5.5.1.5 There may be no point in any vent line where moisture can accumulate with the aeroplane in either the ground or level flight attitudes, unless drainage is provided. Any drain valve installed must be accessible for drainage.

5.5.1.6 No vent may terminate at a point where the discharge of fuel from the vent outlet will constitute a fire hazard or from which fumes may enter personnel compartments.

5.5.1.7 Vents must be arranged to prevent the loss of fuel, except fuel discharged because of thermal expansion, when the aeroplane is parked in any direction on a ramp having a 1 % slope.

5.5.2 Each carburetor with vapor elimination connections and each fuel injection engine employing vapor return provisions must meet the conditions specified in 5.5.2.1 through 5.5.2.2.

5.5.2.1 Each vapor elimination connections and each vapor return provisions must have a separate vent line to lead vapors back to the top of one of the fuel tanks.

5.5.2.2 If there is more than one tank and it is necessary to use these tanks in a definite sequence for any reason, the vapor vent line must lead back to the fuel tank to be used first, unless the relative capacities of the tanks are such that return to another tank is preferable.

5.5.3 For aeroplanes approved for aerobatics, the requirements in 5.5.3.1 through 5.5.3.2 must be prevented for each acrobatic maneuver for which certification is requested.

5.5.3.1 Excessive loss of fuel, including short periods of inverted flight.

5.5.3.2 Siphoning of fuel from the vent when normal flight has been resumed.

5.6 *Sump:*

5.6.1 Each fuel tank must have a drainable sump with an effective capacity, in the normal ground and flight attitudes, of 0.25 % of the tank capacity, or 0.24 L [1⁄16 US-gal], whichever is greater.

5.6.2 Each fuel tank must allow drainage of any hazardous quantity of water from any part of the tank to its sump with the aeroplane in the normal ground attitude.

5.6.3 Each reciprocating engine fuel system must have a sump that meets the requirements of 5.6.3.1 through 5.6.3.3.

5.6.3.1 Have a sediment bowl or chamber that is accessible for drainage.

5.6.3.2 Have a capacity of 30 cm^3 [1 oz] for every 75.7 L [20 US-gal] of fuel tank capacity.

5.6.3.3 Each fuel tank outlet must be located so that, in the normal flight attitude, water will drain from all parts of the tank except the sump to the sediment bowl or chamber.

5.7 *Filler Connection:*

5.7.1 Each fuel tank filler connection must be marked as prescribed in 14 CFR 23.1557(c).

5.7.2 Fuel tank filler connections must be located outside the personnel compartment.

5.7.3 Spilled fuel must be prevented from entering the fuel tank compartment or any part of the aeroplane other than the tank itself.

5.7.4 Each filler cap must provide a fuel-tight seal for the main filler opening. However, there may be small openings in the fuel tank cap for venting purposes or for the purpose of allowing passage of a fuel gauge through the cap provided such openings comply with the requirements of 5.5.1.

5.7.5 Each fuel filling point, except pressure fueling connection points, must have a provision for electrically bonding the aeroplane to ground fueling equipment.

5.7.6 Fuel filler openings should be designed to preclude the use of fuels other than those approved for use.

5.7.6.1 Fuel filler openings no larger than 60 mm [2.36 in.] are appropriate for aeroplanes with engines requiring gasoline as the only permissible fuel.

5.7.6.2 Fuel filler openings no smaller than 75 mm [2.95 in.] are appropriate for aeroplanes with engines requiring turbine fuel as the only permissible fuel.

5.7.7 For single fuel tanks on multiengine aeroplanes the filler caps should be designed to prevent inflight loss, incorrect installation, or have means to indicate that the cap is not properly installed.

5.8 *Strainers & Filters:*

5.8.1 There must be a fuel strainer for the fuel tank outlet or for the booster pump to prevent the passage of any object that could restrict fuel flow or damage any fuel system component.

5.8.1.1 For spark ignition engine powered aeroplanes, the fuel strainer must have 3 to 6 meshes per cm [8 to 16 meshes per in.].

5.8.1.2 The fuel strainer must have a length of at least twice the diameter of the fuel tank outlet.

5.8.1.3 The clear area of each fuel tank outlet strainer must be at least five times the area of the outlet line.

5.8.1.4 The diameter of each strainer must be at least that of the fuel tank outlet.

5.8.1.5 Each strainer must be accessible for inspection and cleaning.

5.8.2 There must be a fuel strainer or filter between the fuel tank outlet and the inlet of either the fuel metering device or an engine driven positive displacement pump, whichever is nearer the fuel tank outlet.

5.8.2.1 The fuel strainer or filter must be accessible for draining and cleaning and must incorporate a screen or element which is easily removable.

5.8.2.2 The fuel strainer or filter must have a sediment trap and drain except that it need not have a drain if the strainer or filter is easily removable for drain purposes.

5.8.2.3 The fuel strainer or filter must be mounted so that its weight is not supported by the connecting lines or by the inlet or outlet connections of the strainer or filter itself, unless adequate strength margins under all loading conditions are provided in the lines and connections.

5.8.2.4 The fuel strainer or filter must have the capacity (with respect to operating limitations established for the engine) to ensure that engine fuel system functioning is not impaired, with the fuel contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine during its type certification.

5.8.3 For Level 4 aeroplanes, unless means are provided in the fuel system to prevent the accumulation of ice on the filter, a means must be provided to automatically maintain the fuel flow if ice clogging of the filter occurs.

5.9 *Tests:*

5.9.1 Each fuel tank must be able to withstand the pressures defined in 5.9.1.1 through 5.9.1.3 without failure or leakage.

5.9.1.1 For each conventional metal tank and nonmetallic tank with walls not supported by the aeroplane structure, a pressure of 24 kPa [3.5 psi], or that pressure developed during maximum ultimate acceleration with a full tank, whichever is greater.

5.9.1.2 For each integral tank, the pressure developed during the maximum limit acceleration of the aeroplane with a full tank, with simultaneous application of the critical limit structural loads.

5.9.1.3 For each nonmetallic tank with walls supported by the aeroplane structure and constructed in an acceptable manner using acceptable basic tank material, and with actual or simulated support conditions, a pressure of 14 kPa [2 psi] 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.

5.9.2 For aeroplane with more than one engine or with more than two seats or with a maximum takeoff weight of more than 750 kg [1650 lb] or a stall speed above 83 km/h [45 knots], each fuel tank with large, unsupported, or unstiffened flat surfaces whose failure or deformation could cause fuel leakage, must be able to withstand the test defined in 5.9.2.1 through 5.9.2.2 without leakage, failure, or excessive deformation of the tank walls: