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Standard Specification for Aircraft Fuel Storage and Delivery[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 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. Annex A1 maps the Means of Compliance described in this specification to EASA CS-23, amendment 5, or later, and FAA 14 CFR Part 23, amendment 64, or later.

1.4 *Units*—The values stated are SI units followed by imperial units in brackets. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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

F3117/F3117M Specification for Crew Interface in Aircraft

F3179/F3179M Specification for Performance of Aircraft

F3397/F3397M Practice for Aeroplane Turbine Fuel System Hot Weather Operations

2.2 *EASA Standards:*[3]

CS-23 Normal, Utility, Aerobatic and Commuter Aeroplanes

CS-34 Easy Access Rules for Aircraft Engine Emissions and Fuel Venting

2.3 *FAA Standards:*[4]

14 CFR Part 23 Airworthiness Standards: Normal Category Airplanes

14 CFR Part 34 Fuel Venting and Exhaust Emission Requirements for Turbine Engine Powered Airplanes

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:*

[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.

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[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 European Union Aviation Safety Agency (EASA), Konrad-Adenauer-Ufer 3, D-50668 Cologne, Germany, https://www.easa.europa.eu.

[4] Available from Federal Aviation Administration (FAA), 800 Independence Ave., SW, Washington, DC 20591, http://www.faa.gov.

3.3.1 *cc*—cubic centimetre

3.3.2 *CFR*—Code of Federal Regulations

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 United States 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 it meets the requirement of 4.1.4.1 or 4.1.4.2.

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

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 4.2.2.4 and 5.7.7 must be met.

4.2.2.1 There shall be an independent tank outlet for each engine.

4.2.2.2 There shall be 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.

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

4.2.2.4 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 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 purpose of draining hazardous quantities of water, as required by 5.6, 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 Specification F3117/F3117M.

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 meshes to 6 meshes per centimeter [8 meshes to 16 meshes per inch].

5.8.1.2 The fuel strainer must either:

(1) have a length of at least twice the diameter of the fuel tank outlet, or

(2) have a clear area of each fuel tank outlet strainer at least five times the area of the outlet line.

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

5.8.1.4 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:

5.9.2.1 Each complete tank assembly and its support must be vibration tested under conditions that simulate the actual installation.

5.9.2.2 Except as specified in 5.9.3.4, the tank assembly must be vibrated for 25 h at a total displacement of not less than 0.8 mm [$^{1}/_{32}$ in.] (unless another displacement is substantiated) while $^{2}/_{3}$ filled with water or other suitable test fluid.

5.9.3 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], aeroplane the test frequency of vibration must meet the requirements defined in 5.9.3.1 through 5.9.3.7:

5.9.3.1 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 the number of cycles per minute obtained by multiplying the maximum continuous propeller speed in rpm by 0.9 for propeller-driven aeroplanes, and for non-propeller driven aeroplanes the test frequency of vibration is 2000 cycles per minute.

5.9.3.2 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.

5.9.3.3 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.

5.9.3.4 Under 5.9.3.2 and 5.9.3.3, the time of test must be adjusted to accomplish the same number of vibration cycles that would be accomplished in 25 h at the frequency specified in 5.9.3.1.

5.9.3.5 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 h.

5.9.3.6 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 5.9.3.1 through 5.9.3.4.

5.9.3.7 Each tank with a nonmetallic liner must be subjected to the sloshing test outlined in 5.9.3.5, with the fuel at room temperature. In addition, a specimen liner of the same basic construction as that to be used in the aeroplane must, when installed in a suitable test tank, withstand the sloshing test with fuel at a temperature of 43 °C [110 °F].

5.10 *Unusable Fuel Supply:*

5.10.1 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.

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

5.11 *Flow Between Interconnected Tanks:*

5.11.1 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 5.10, except that full tanks must be used.

5.11.2 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 aeroplane component can occur because of overfilling of any tank.

6. Fuel Pumps

6.1 *Main Pumps:*

6.1.1 For reciprocating engine installations, the main pump must be directly driven by the engine or meet the turbine engine requirements found in 6.1.2.

6.1.2 For turbine engine installations, the main pump must meet the requirements of 6.1.2.1 through 6.1.2.3.

6.1.2.1 There must be at least one main pump.

6.1.2.2 The power supply for the main pump for each engine must be independent of the power supply for each main pump for any other engine.

6.1.2.3 Provision must be made to allow the bypass of each positive displacement fuel pump other than a fuel injection pump approved as part of the engine.

6.2 *Emergency Pump:*

6.2.1 There must be an emergency pump immediately available to supply fuel to the engine if any main pump (other than a fuel injection pump approved as part of an engine) fails.

6.2.2 The power supply for each emergency pump must be independent of the power supply for each corresponding main pump.

6.3 If both the main pump and emergency pump operate continuously, there must be a means to indicate to the appropriate flight crewmembers a malfunction of either pump.

6.4 Operation of any fuel pump may not affect engine operation so as to create a hazard, regardless of the engine power or thrust setting or the functional status of any other fuel pump.

7. Fuel Flow

7.1 *General:*

7.1.1 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.

7.1.1.1 The quantity of fuel in the tank may not exceed the amount established as the unusable fuel supply for that tank under 5.10.1 plus that quantity necessary to show compliance with this section.

7.1.1.2 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.

7.1.1.3 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.

7.1.1.4 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.

7.2 *Gravity Systems*—The fuel flow rate for gravity systems (main and reserve supply) must be 150 % of the takeoff fuel consumption of the engine.

7.3 *Pump Systems:*

7.3.1 The fuel flow rate for each pump system (main and reserve supply) for each spark ignition reciprocating engine must be 125 % and for each compression ignition reciprocating engine 100 % of the fuel flow required by the engine at the maximum takeoff power approved under this part.

7.3.2 The flow rate established in 7.3.1 is required for each main pump and each emergency pump, and must be available when the pump is operating as it would during takeoff.

7.3.3 For each hand-operated pump, the flow rate established in 7.3.1 must occur at not more than 60 complete cycles (120 single strokes) per minute.

7.3.4 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.

7.4 *Auxiliary Fuel Systems and Fuel Transfer Systems:*

7.4.1 Subsections 7.2, 7.3, and 7.6 apply to each auxiliary and transfer system, with the exception listed in 7.4.1.1 through 7.4.1.2.

7.4.1.1 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.

7.4.1.2 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.

(1) This lesser flow rate must be adequate to maintain engine maximum continuous power but the flow rate must not overfill the main tank at lower engine powers.

7.5 *Multiple Fuel Tanks:*

7.5.1 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 % maximum continuous power or full power and fuel pressure for on that engine in not more than:

7.5.1.1 Ten seconds (10 s) for naturally aspirated single-engine aeroplanes.

7.5.1.2 Twenty seconds (20 s) for turbocharged single-engine aeroplanes, provided that 75 % maximum continuous naturally aspirated power is regained within 10 s.

7.5.1.3 Twenty seconds (20 s) for multiengine aeroplanes.

7.6 *Turbine Engine Fuel Systems:*

7.6.1 Each turbine engine fuel system must provide at least 100 % of the fuel flow required by the engine under each intended operation condition and maneuver. The conditions may be simulated in a suitable mockup.

7.6.1.1 Fuel flow must be shown with the aeroplane in the most adverse fuel feed condition (with respect to altitudes, attitudes, and other conditions) that is expected in operation.

7.6.1.2 For multiengine aeroplanes, notwithstanding the lower flow rate allowed by 7.4 of this standard, fuel flow must be automatically uninterrupted with respect to any engine until all the fuel scheduled for use by that engine has been consumed. In addition, fuel flow must meet the requirements of 7.6.1.2*(1)* through *(3)*.

(1) 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.

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

(3) For the purposes of this section no pilot action must be required after completion of the engine starting phase of operations.

7.6.1.3 For single-engine aeroplanes, require no pilot action after completion of the engine starting phase of operations unless means are provided that unmistakenly alert the pilot to take any needed action at least 5 min prior to the needed action.

(1) Such pilot action must not cause any change in engine operation.

(2) Such pilot action must not distract pilot attention from essential flight duties during any phase of operations for which the aeroplane is approved.

7.7 *Hot Weather Operation:*

7.7.1 Each fuel system must be free from vapor lock when using fuel at its critical temperature, with respect to vapor formation, when operating the aeroplane in all critical operating and environmental conditions for which approval is requested.

7.7.1.1 For wide-cut turbine fuels, the initial fuel temperature shall be 43 °C to 45 °C [110 °F to 115 °F] or the maximum outside air temperature for which approval is requested, whichever is more critical.

7.7.1.2 For kerosene-type turbine fuels, Practice F3397/F3397M shall be used for meeting the requirements of 7.7.1.

8. Pressure Fueling Systems

8.1 Each pressure fueling system fuel manifold connection must have means to prevent the escape of hazardous quantities of fuel from the system if the fuel entry valve fails.

8.2 An automatic shutoff means must be provided to prevent the quantity of fuel in each tank from exceeding the maximum quantity approved for that tank. In addition, the automatic shutoff means must meet the requirements of 8.2.1 through 8.2.2.

8.2.1 Allow checking for proper shutoff operation before each fueling of the tank.

8.2.2 For Level 4 aeroplanes, indicate at each fueling station, a failure of the shutoff means to stop the fuel flow at the maximum quantity approved for that tank.

8.3 A means must be provided to prevent damage to the fuel system in the event of failure of the automatic shutoff means prescribed in 8.2.

8.4 All parts of the fuel system up to the tank which are subjected to fueling pressures must have a proof pressure of 1.33 times, and an ultimate pressure of at least 2.0 times, the surge pressure likely to occur during fueling.

8.5 The airplane defueling system (not including fuel tanks and fuel tank vents) must withstand an ultimate load that is 2.0 times the load arising from the maximum permissible defueling pressure (positive or negative) at the airplane fueling connection.

9. Fuel Jettisoning System

9.1 If the design landing weight is less than that permitted under the requirements of Specification F3116/F3116M, the aeroplane must have a fuel jettisoning system installed. The jettison system must meet the requirements of 9.1.1 through 9.1.2.

9.1.1 The jettison system must be able to jettison enough fuel to bring the maximum weight down to the design landing weight.

9.1.2 The average rate of fuel jettisoning must be at least 1 % of the maximum weight per minute, except that the time required to jettison the fuel need not be less than 10 min.

9.2 Fuel jettisoning must be demonstrated at maximum weight with flaps and landing gear up and in configurations described in 9.2.1 through 9.2.3.

9.2.1 A power-off glide at 1.4 V_{S1}.

9.2.2 A climb, at the speed at which the one-engine-inoperative enroute climb data have been established in accordance with Specification F3179/F3179M, with the critical engine inoperative and the remaining engines at maximum continuous power.

9.2.3 Level flight at 1.4 V_{S1}, if the results of the tests in the conditions specified in 9.2.1 and 9.2.2 show that this condition could be critical.

9.3 During the flight tests prescribed in 9.2, items defined in 9.3.1 – 9.3.4 must be demonstrated.

9.3.1 The fuel jettisoning system and its operation are free from fire hazard.

9.3.2 The fuel discharges clear of any part of the aeroplane.

9.3.3 Fuel or fumes do not enter any parts of the aeroplane.

9.3.4 The jettisoning operation does not adversely affect the controllability of the aeroplane.

9.4 For all non-turbine engine powered aeroplanes, the jettisoning system must meet the requirements of 9.4.1 or 9.4.2.

9.4.1 The jettison system shall be designed so that it is not possible to jettison the fuel in the tanks used for takeoff and landing below the level allowing 45 min flight at 75 % maximum continuous power.

9.4.2 The jettison system may be designed to jettison all the fuel if there is an auxiliary control independent of the main jettison control.

9.5 For turbine engine powered aeroplanes, the jettisoning system must be designed so that it is not possible to jettison fuel in the tanks used for takeoff and landing below the level allowing climb from sea level to 3048 m [10 000 ft] and thereafter allowing 45 min cruise at a speed for maximum range.

9.6 The fuel jettisoning valve must be designed to allow flight crewmembers to close the valve during any part of the jettisoning operation.

9.7 Unless it is shown that using any means (including flaps, slots, and slats) for changing the airflow across or around the wings does not adversely affect fuel jettisoning, there must be a placard, adjacent to the jettisoning control, to warn flight crewmembers against jettisoning fuel while the means that change the airflow are being used.

9.8 The fuel jettisoning system must be designed so that any reasonably probable single malfunction in the system will not result in a hazardous condition due to unsymmetrical jettisoning of, or inability to jettison, fuel.

ANNEX

(Mandatory Information)

A1. CORRELATION OF STANDARD – CONTENT AND THE RULES

A1.1 Means of Compliance Correlation Sorted by Standard Section

NOTE A1.1—The specification sections shown in the specification column will be at the highest level at which everything below that level is the same as the level shown.