ETSO-C76b
Date: 5.8.2016

European Aviation Safety Agency

European Technical Standard Order

Subject: FUEL DRAIN VALVES

1 — Applicability

This ETSO provides the requirements which Fuel Drain Valves that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures

2.1 — General

Applicable procedures are detailed in CS-ETSO, Subpart A.

2.2 — Specific

None.

3 — Technical Conditions

3.1 — Basic

3.1.1 — Minimum Performance Standard

Standards set forth in Appendix 1, MINIMUM PERFORMANCE STANDARD (MPS) FOR FUEL DRAIN VALVES, dated 18 april 2012.

3.1.2 — Environmental Standard

As specified in Section 3 of Appendix 1.

3.1.3 — Computer Software

None.

3.1.4 — Electronic Hardware Qualification

None.

3.2 — Specific

None.

3.2.1 — Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

4 — Marking

4.1 — General

Marking is detailed in CS-ETSO, Subpart A, paragraph 1.2.

4.2 — Specific

None.

5 — Availability of Referenced Document

See CS-ETSO, Subpart A, paragraph 3.

APPENDIX 1

MINIMUM PERFORMANCE STANDARD (MPS) FOR FUEL DRAIN VALVES

1. PURPOSE: This Appendix provides the MPS for fuel drain valves that are intended to drain fuel or water from low points in aircraft fuel systems. Fluid discharge from the valve is intended to be drained into a container for inspection. Depending on the intended application and configuration of specific equipment, the performance may be enhanced, or made superior to this specification. The number of test samples shall be completed in accordance with **Table 1.**

2. SCOPE: The MPS covers the requirements for acceptance of fuel drain valves used as a quick means of draining fuel or water from aircraft fuel systems. These valves are intended to be used in fuel tank sumps, strainers and gascolators.

3. GENERAL REQUIREMENTS

a. Materials

(1) High-quality materials that are suitable for use with aviation fuels having an aromatic content from 0–30 % shall be used.

(2) Synthetic rubber parts age-dated in accordance with the SAE International's Aerospace Recommended Practice (ARP) 5316C 'Storage of Elastomer Seals and Seal Assemblies Which Include an Elastomer Element Prior to Hardware Assembly', dated 6 December, 2010, shall be used.

(3) The fuel drain valve shall be designed by using corrosion and galling resisting metals or metals protected to resist corrosion and galling during the normal service life of the valve.

(4) The use of magnesium or any magnesium alloy **is prohibited.**

b. Design and Construction.

(1) Fuel Spillage. The drain valve shall be designed to allow operation without spilling or leaking fuel on personnel. The valve shall be designed to a 'Fail-Closed' condition.

(2) Position Indication.
(a) An indication for the open and closed position of valves shall be provided.
(b) A legend for position indication marking shall be used.
(c) Detents or other suitable means to keep the valve in the full-closed position shall be used.
(d) The valve must automatically return to the closed position when manually released from the open position.

(3) Self-locking. A means to prevent accidental opening or opening of the valve due to vibration or air loads shall be provided.

(4) Seals. The valve shall be designed so that:
(a) The inlet fuel pressure does not open the valve, and
(b) The inlet pressure keeps the valve in the closed and sealed position.

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(5) Loss of Parts.
(a) Fuel drain valves shall be designed to prevent the loss of parts.
(b) The valve shall be designed so the main seal will remain in place to prevent fuel from leaking in the event of possible damage or loss of the valve stem from operational loads anticipated in service.
(c) If threaded fittings are used to support the valve, the fittings shall be designed to prevent operational loads from rotating the valve body out of its boss or closed position.

(6) Screens. The valve shall be designed so that fuel tank features, such as screens or baffles, do not impair the valves effectiveness in draining fuel containing water and other contaminants.

c. Test Conditions.

(1) Atmospheric Conditions. Unless otherwise specified, all tests required by this standard shall be conducted at an atmospheric pressure of approximately 29.92 inches of mercury, ± 2 inches, and an ambient temperature of approximately 25 °C, ± 2 °C. When testing with atmospheric pressure or temperature different from these values, any variation due to the test setup shall be accounted for. The reason for varying from the specified conditions must be justified.

(2) Fluids. The type of fluid used must be specified unless commercial grade aviation fuels are used for all tests.

d. Test Methods and Performance Requirements.

(1) Functional. The ability of the valve to meet the design requirements specified in paragraphs **3.b.(1)** through **3.b.(6)** of this Appendix shall be demonstrated.

(2) Flow Test. The drain valve shall be connected to a suitable container and the time required to pass 1 quart of fuel with a maximum head of 6 inches of fuel shall be determined. The time to flow 1 quart must not take longer than 1 minute.

(3) Leakage Tests.

(a) Fuel Leakage. The fuel leakage test shall be conducted at pressures of 4 inches of fuel, 1 psi ± 0.1 psi, 20 psi ± 2 psi, and 60 psi ± 2 psi. The pressure to the drain valve inlet shall be applied with the valve in the closed position. The fuel drain valve must not leak any fuel from discharge or outlet port. Refer to **Figure 1** for test profile.

(b) Air Leakage. The air leakage test shall be conducted with the valve installed in a suitable test setup so the valve inlet port is covered by fuel. Air pressure shall be applied varying successively from 0.0 to 5.0 psi, with a tolerance of ± 10 % in each applied pressure, to the valve outlet port with the valve in the closed position. The fuel drain valve must not leak any air into the valve inlet. Refer to **Figure 2** for test profile.

(4) Fuel Resistance and Extreme Temperature. The fuel resistance and extreme temperature tests shall be conducted as specified in **Table 2**.

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(5) Vibration

(a) Resonance. The valve shall be subjected to a resonant frequency survey of the range specified in **Table 3** to determine if there are any resonant frequencies of the parts. If resonance is encountered, the valve shall be vibrated successively axis by axis along the three axes for four hours at the critical frequency.

(b) Cycling. The valve shall be mounted on a vibration device and fluid pressure shall be applied to the inlet port in the closed position. The valve shall be subjected to the three vibration scanning cycle tests in accordance with **Table 3.**

(c) With pressures of 0.5 psi ± 0.1 psi and 5.0 psi ± 0.5 psi, the valve shall be subjected to vibration cycle tests listed in **Table 3.** There must not be any fluid leaking during the tests.

(d) With air pressure varying successively from 0.0 to 5.0 psi gauge at the outlet port, the valve shall be subjected to vibration cycle tests listed in **Table 3.** Air leakage must not exceed 10 cc. per minute of free air during the 5.0 psi air suction test.

(e) The valve must not have damaged or loose parts as a result of the vibration tests.

(6) Proof Pressure

(a) With the valve in the closed position, a fuel pressure of 100 ± 2 psi for one minute at the inlet port shall be applied, with the outlet port open to atmospheric pressure.

(b) The valve must not show any evidence of permanent distortion or other damage. The valve must not have any external leaking when the pressure is uniformly reduced to 60 psi. Refer to **Figure 3** for test profile.

(7) Flammability. All materials used must be self-extinguishing when tested inaccordance with applicable requirements of RTCA/DO-160E or later as defined in CS-ETSO, Subpart A, paragraph 2.1., Section 26, Category C, Flammability Test. This requirement does not apply to small parts (where the greatest dimension of equipment (L) is less than 50 mm, such as knobs, fasteners, seals, grommets and small electrical parts) that would not propagate a fire.

(8) Reliability Tests. (Cycling Operations)

(a) Dry Test. The valve shall be dried in an oven at 158° ±2° F for four hours. Then the valve shall be subjected to 2 000 complete cycles of operation in the dry condition.

(b) Wet Test. The valve shall be moistened with fuel, supplied with a 6-inch head of fuel and then subjected to 6 000 complete cycles of operation. The fuel head must remain at six inches during the test.

(c) Post Reliability Test. After the cycling operations, the leakage test shall be performed. The valve must not leak as a result of the reliability test.

e. Test Samples.

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Table 1 Test Samples

Tests	**Paragraph 2 of this Appendix**	**Samples**
Functional	d.(1)	Valve 1
Flow Test	d.(2)	Valve 2
Fuel Leakage	d.(3)	Valve 3
Air Leakage	d.(3)	Valve 3
Fuel Resistance and Extreme Temperature	d.(4)	Valve 4
Resonance	d.(5)	Valve 5
Cycling	d.(5)	Valve 6
Proof Pressure	d.(6)	Valve 7
Fire Flammability Test	d.(7)	Valve 8
Reliability Test, Dry	d.(8)	Valve 9
Reliability Test, Wet	d.(8)	Valve 9
Post Reliability Test	d.(8)	Valve 9

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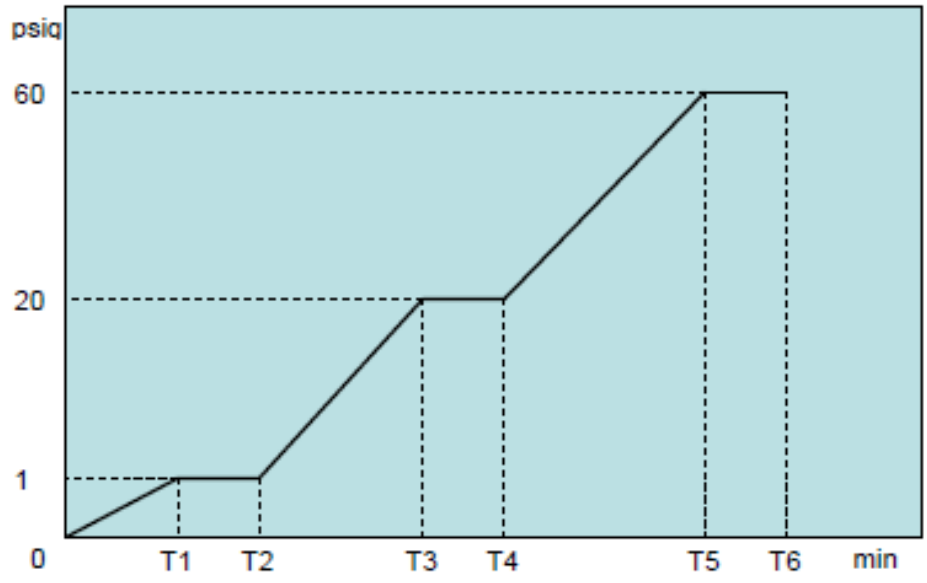
Figure 1 – Fuel Leakage Test



Notes:
T0 to T1 ----- No time restriction
T1 to T2 ----- 5 minutes minimum
T2 to T3 ----- No time restriction
T3 to T4 ----- 5 minutes minimum
T4 to T5 ----- No time restriction
T5 to T6 ----- 5 minutes minimum

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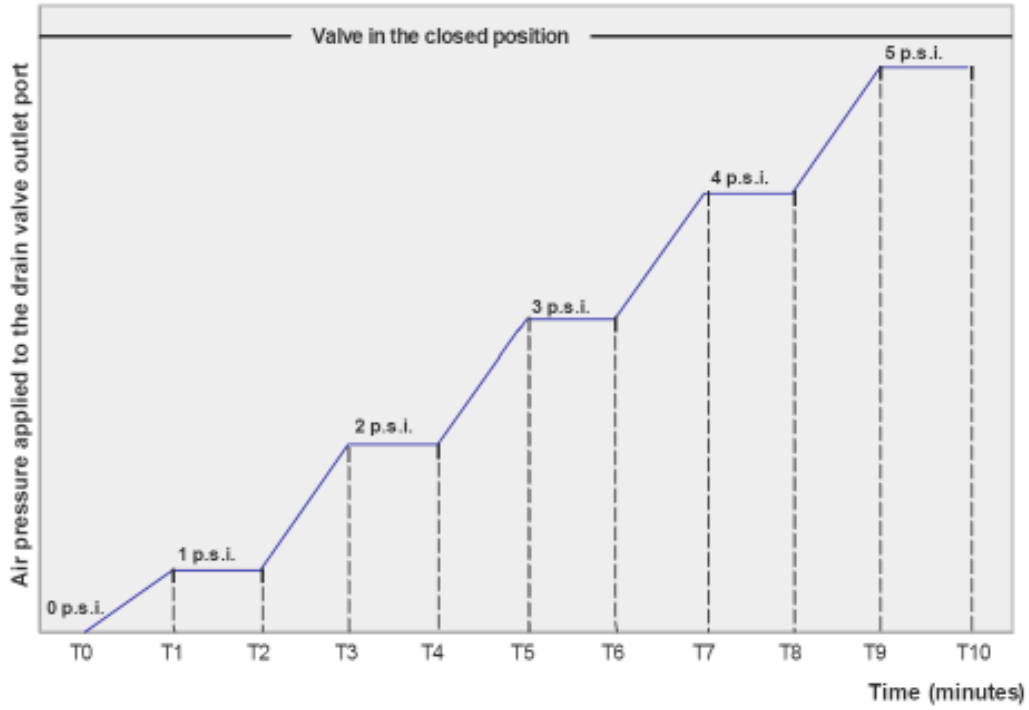
Figure 2 – AIR Leakage Test



Notes : T0 to T1 -- no time restriction
T1 to T2 -- 1 minute, minimum.
T2 to T3 -- no time restriction.
T3 to T4 -- 1 minute, minimum.
T4 to T5 -- no time restriction.
T5 to T6 -- 1 minute, minimum.
T6 to T7 -- no time restriction.
T7 to T8 -- 1 minute, minimum.
T8 to T9 -- no time restriction.
T9 to T10 -- 1 minute, minimum
T10 -- end of test.

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Table 2 - Fuel Resistance and Extreme Temperature Test Schedule

Test	**Fuel Resistance**		
Period ***Note 1***	Phase I — Soak	Phase I — Dry	Low Temperature
Component configuration	***Note 2***	Drained and blown dry, normal condition as expected under service conditions, ports open	Mounted as expected under normal service conditions ***Note 2***
Test Fluid	*ASTM D471 Reference Fuel B	None	*ASTM D471 Reference Fuel A
Period duration	96 hours (4 days)	24 hours	18 hours
Ambient and test fluid temperature	158° ±2° F (70° ±2° C)or the normal operating temperature of the system where the component is used, whichever is higher	Circulating air at 158° ±2° F (70° ±2° C)or the normal operating temperature of the system in which the component is used, whichever is higher ***Note 4***	Fluid temperature lowered to -67°±2°F, (-55° ±2° C) then the fluid temperature shall be maintained at -67°±2° F (-55° ±2° C) for a minimum of 18 hours
Operation or tests during period	Component actuated at least 4 cycles per day in a normal manner ***Note 3***	None	None
Operation or tests Immediately after period	Leakage test shall be conducted, using *ASTM D471 Reference Fuel B	(a) Components actuated for 5 cycles. (b) Functional and leakage tests to be conducted in accordance with paragraphs 3.d.(1) and 3.d.(3) of this appendix, using *ASTM D471, Reference Fuel A ***Note 3***	With temperature not higher than -65° F (-54° C), functional and leakage tests to be conducted in accordance with paragraphs 3.d.(1) and 3.d.(3) of this appendix, using *ASTM D471, Reference Fuel A

Notes:

1. Each period shall be followed immediately (45 minutes maximum) after the preceding one in the order noted.
2. The component shall be maintained to ensure complete contact of all non-metallic parts with the test fluid as would be expected under normal service conditions.
3. There is no restriction in the actuation of the valve.
4. There is no restriction in the circulating velocity of air or mass flow.

* ASTM: American Society for Testing of Materials, International

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Table 3 — Vibration Test

Scanning cycle test	**1**	**2**	**3**
Axis of vibration	X	Y	Z
Fluid pressure	60 psi ± 2 psi	60 psi ± 2 psi	60 psi ± 2 psi
Scanning cycle time	15 min	15 min	15 min
Number of scanning cycles per test	2	2	2
Procedure	1. The valve shall be tested along three mutually perpendicular X, Y, and Z-axes; the X axis lies along centre lines of the valve. 2. The frequency time shall be increased uniformly through a range from 10 to 500 c.p.s. with an applied double amplitude of 0.036 inch up to 75 c.p.s. and an applied vibration acceleration not less than ±10g. 3. Double amplitude indicates the total displacement from positive to negative maximum. 4. The frequency shall be decreased so the complete cycle is accomplished in the specified cycle time.		