Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, D.C.

TSO-C76b

Effective
Date: 04/18/2012

Technical Standard Order

Subject: FUEL DRAIN VALVES

1. PURPOSE. This technical standard order (TSO) is for manufacturers applying for a TSO authorization (TSOA) or letter of design approval (LODA). In it, we (the Federal Aviation Administration, (FAA)) tell you what minimum performance standards (MPS) your fuel drain valve must first meet for approval and identification with the applicable TSO marking.

2. APPLICABILITY. This TSO affects new applications submitted after its effective date.

a. All prior revisions to this TSO are no longer effective. Generally, we will not accept applications for prior TSO revisions after the effective date of this TSO. We may do so, however, up to six months after the effective date of the latest revision, if we know that you were working against the earlier MPS before the new change became effective.

b. All fuel drain valves approved under a previous TSOA may still be manufactured under the provisions of its original approval.

3. REQUIREMENTS. New models of fuel drain valves identified and manufactured on or after the effective date of this TSO must meet the MPS qualifications and documentation requirements in this TSO and appendix 1.

a. Functionality. This TSO's standards apply to fuel drain valves used as a means to on-ground drain fuel or water from aircraft fuel tank sumps, fuel strainers, and gascolators.

b. Failure Condition Classifications. There is no standard minimum failure condition classification for this TSO. The failure condition classification appropriate for the equipment will depend on the intended use of the equipment in a specific aircraft. Document the loss of function and malfunction failure condition classification for which the equipment is designed.

c. Functional Qualification. Demonstrate the required performance under the test conditions in section 3 of appendix 1 of this TSO.

d. Environmental Qualification. Demonstrate the required performance under the test procedures in section 3 of appendix 1 of this TSO using standard environmental conditions and test procedures appropriate for airborne equipment.

e. Deviations. We have provisions for using alternate or equivalent means of compliance to the criteria in the MPS of this TSO. If you invoke these provisions, you must show that your equipment maintains an equivalent level of safety. Apply for a deviation under the provision of 14 CFR 21.618.

4. MARKING.

a. Mark at least one major component permanently and legibly with all the information in 14 CFR 45.15(b). The marking must include the serial number.

b. Also, mark the following permanently and legibly, with at least the manufacturer's name, subassembly part number, and the TSO number:

(1) Each component that is easily removable (without hand tools); and,

(2) Each subassembly of the article that you determined may be interchangeable.

5. APPLICATION DATA REQUIREMENTS. You must give the FAA aircraft certification office (ACO) manager responsible for your facility a statement of conformance, as specified in 14 CFR 21.603(a)(1) and one copy each of the following technical data to support your design and production approval. LODA applicants must submit the same data (excluding paragraph **5.e**) through their civil aviation authority.

a. A Manual(s) containing the following:

(1) Operating instructions and equipment limitations sufficient to describe the equipment's operational capability.

(2) Describe in detail any deviations.

(3) Installation procedures and limitations sufficient to ensure that the fuel drain valve, when installed according to the installation or operational procedures, still meets this TSO's requirements. Limitations must identify any unique aspects of the installation. The limitations must include a note with the following statement:

> "This article meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this article requires separate approval."

(4) A summary of the test conditions used for environmental qualifications for each component of the article.

(5) Schematic drawings, wiring diagrams, and any other documentation necessary for installation of the fuel drain valve.

(6) List of replaceable components, by part number, that makes up the fuel drain valve. Include vendor part number cross-references, when applicable.

b. Instructions covering periodic maintenance, calibration, and repair, for the continued airworthiness of fuel drain valve. Include recommended inspection intervals and service life, as appropriate.

c. A drawing depicting how the article will be marked with the information required by paragraph **4** of this TSO.

d. Identify functionality or performance contained in the article not evaluated under paragraph **3** of this TSO (that is, non-TSO functions). Non-TSO functions are accepted in parallel with the TSO authorization. For those non-TSO functions to be accepted, you must declare these functions and include the following information with your TSO application:

(1) Description of the non-TSO function(s), such as performance specifications, failure condition classifications, software, hardware, and environmental qualification levels. Include a statement confirming that the non-TSO function(s) don't interfere with the article's compliance with the requirements of paragraph **3**.

(2) Installation procedures and limitations sufficient to ensure that the non-TSO function(s) meets the declared functions and performance specification(s) described in paragraph **5.d.(1)**.

(3) Instructions for continued performance applicable to the non-TSO function(s) described in paragraph **5.d.(1).**

(4) Interface requirements and applicable installation test procedures to ensure compliance with the performance data defined in paragraph **5.d.(1).**

(5) Test plans, analysis and results, as appropriate, to verify that performance of the hosting TSO article is not affected by the non-TSO function(s).

(6) Test plans, analysis and results, as appropriate, to verify the function and performance of the non-TSO function(s) as described in paragraph **5.d.(1).**

e. The quality system description required by 14 CFR 21.608, including functional test specifications. The quality system should ensure that you will detect any change to the approved design that could adversely affect compliance with the TSO MPS, and reject the article accordingly. (Not required for LODA applicants.)

f. Material and process specifications list.

g. List of all drawings and processes (including revision level) that define the article's design.

h. Manufacturer's TSO qualification report showing results of testing accomplished according to paragraph **3.c** and **3.d** of this TSO.

6. MANUFACTURER DATA REQUIREMENTS. Besides the data given directly to the responsible ACO, have the following technical data available for review by the responsible ACO:

a. Functional qualification specifications for qualifying each production article to ensure compliance with this TSO.

b. Article calibration procedures.

c. Schematic drawings.

d. Material and process specifications.

e. The results of the environmental qualification tests conducted according to paragraphs **3.c** and **3.d** of this TSO.

f. If the article contains non-TSO function(s), you must also make available items **6.a** through **6.e** as they pertain to the non-TSO function(s).

7. FURNISHED DATA REQUIREMENTS.

a. If furnishing one or more articles manufactured under this TSO to one entity (such as an operator or repair station), provide one copy or on-line access to the data in paragraphs **5.a** and **5.b** of this TSO. Add any other data needed for the proper installation, certification, use, or for continued compliance with the TSO, of the fuel drain valves

b. If the article contains declared non-TSO function(s), include one copy of the data in paragraphs **5.d.(1)** through **5.d.(4).**

8. HOW TO GET REFERENCED DOCUMENTS.

a. Order RTCA documents from RTCA Inc., 1150 18th Street NW, Suite 910, Washington, D.C. 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also order copies online at www.rtca.org.

b. Order SAE documents from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Telephone (724) 776-4970, fax (724) 776-0790. You can also order copies online at www.sae.org.

c. Order copies of 14 CFR parts 21 and 45 from the Superintendent of Documents, Government Printing Office, P.O. Box 979050, St. Louis, MO 63197. Telephone (202) 512-1800, fax (202) 512-2250. You can also order copies online at www.access.gpo.gov. Select "Access," then "Online Bookstore." Select "Aviation," then "Code of Federal Regulations."

d. You can find a current list of technical standard orders and advisory circulars on the FAA Internet website Regulatory and Guidance Library at http://rgl.faa.gov/. You will also find the TSO Index of Articles at the same site.

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APPENDIX 1. MINIMUM PERFORMANCE STANDARD (MPS) FOR FUEL DRAIN VALVES

1. PURPOSE: This appendix explains minimum performance standards (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. You may enhance the performance of specific equipment, or make it superior to this specification, depending on your intended application and configuration. The number of test samples shall be completed in accordance to **table 1**.

2. SCOPE: The minimum performance standards (MPS) cover 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) Use high quality materials that are suitable for use with aviation fuels having an aromatic content from 0 to 30 percent.

(2) Use synthetic rubber parts age dated in accordance with 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 December 6, 2010.

(3) Construct the fuel drain valve with 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. Design the drain valve to allow operation without spilling or leaking fuel on personnel. Design the valve to a "Fail-Closed" condition.

(2) Position Indication.

(a) Provide an indication for the open and closed position of valves.

(b) Use a legend for position indication marking.

(c) Use detents or other suitable means to keep the valve in the full-closed position.

(d) The valve must automatically return to the closed position when manually released from the open position.

(3) Self-locking. Provide a means to prevent accidental opening or opening of the valve due to vibration or air loads.

(4) Seals. Design the valve 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.

(5) Loss of Parts.

(a) Design fuel drain valves to prevent the loss of parts.

(b) Design the valve 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 you use threaded fittings to support the valve, design the fittings to prevent operational loads from rotating the valve body out of its boss or closed position.

(6) Screens. Design the valve so 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, conduct all tests required by this standard at an atmospheric pressure of approximately 29.92 inches of mercury, +/-2 inches, and an ambient temperature of approximately 25° C, +/- 2°. When testing with atmospheric pressure or temperature different from these values, account for any variation due to the test setup. You must justify the reason for varying from the specified conditions.

(2) Fluids. You must specify the type of fluid used unless you use commercial grade aviation fuels for all tests.

d. Test Methods and Performance Requirements.

(1) Functional. Demonstrate the ability of the valve to meet the design requirements specified in paragraphs **3.b.(1)** through **3.b.(6)** of this appendix.

(2) Flow Test. Connect the drain valve to a suitable container and determine the time required to pass 1 quart of fuel with a maximum head of six inches of fuel. The time to flow 1 quart cannot take longer than 1 minute.

(3) Leakage Tests.

(a) Fuel Leakage. Conduct the fuel leakage test at pressures of four inches of fuel, 1 psi +/- 0.1 psi, 20 psi. +/- 2 psi, and 60 psi +/- 2 psi. Apply the pressure to the drain valve inlet with the valve in the closed position. The fuel drain valve must not leak any fuel from discharge or outlet port. See **Figure 1** for test profile.

(b) Air Leakage. Conduct the air leakage test with the valve installed in a suitable test setup so the valve inlet port is covered by fuel. Apply air pressure 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. See **Figure 2** for test profile.

(4) Fuel Resistance and Extreme Temperature. Conduct the fuel resistance and extreme temperature tests specified in **Table 2**.

(5) Vibration.

(a) Resonance. Subject the valve to a resonant frequency survey of the range specified in **Table 3** to determine if there are any resonant frequencies of the parts. If you encounter resonance, successively vibrate the valve axis by axis along the three axes for four hours at the critical frequency.

(b) Cycling. Mount the valve, in the closed position, on a vibration device, and apply fluid pressure to the inlet port. Subject the valve to the three vibration scanning cycle tests in **Table 3**.

(c) With pressures of 0.5 psi +/- 0.1 psi and 5.0 psi +/- 0.5 psi, subject the valve to vibration cycle tests listed in table 3. There cannot 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, subject the valve to vibration cycle tests listed in table 3. Air leakage cannot exceed 10 cc. per minute of free air during the 5.0 psi air suction test.

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

(6) Proof Pressure.

(a) With the valve in the closed position, apply a fuel pressure of 100 ± 2 psi for one minute at the inlet port, 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. See **Figure 3** for test profile.

(7) Flammability. All materials used must be self-extinguishing when tested in accordance with applicable requirements of RTCA/DO-160E, 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. Dry the valve in an oven at 158° ±2° F for four hours. Then subject the valve to 2,000 complete cycles of operation in the dry condition.

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

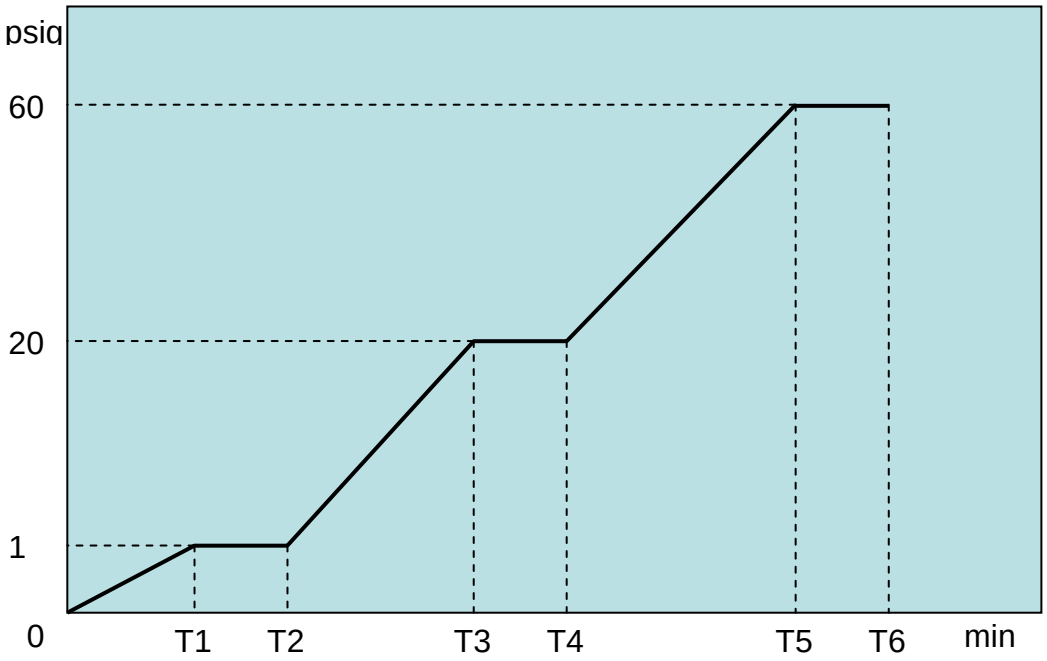
(c) Post Reliability Test. After the cycling operations, perform the leakage test. The valve must not leak as a result of the reliability test.

e. Test Samples.

Table 1 - Test Samples

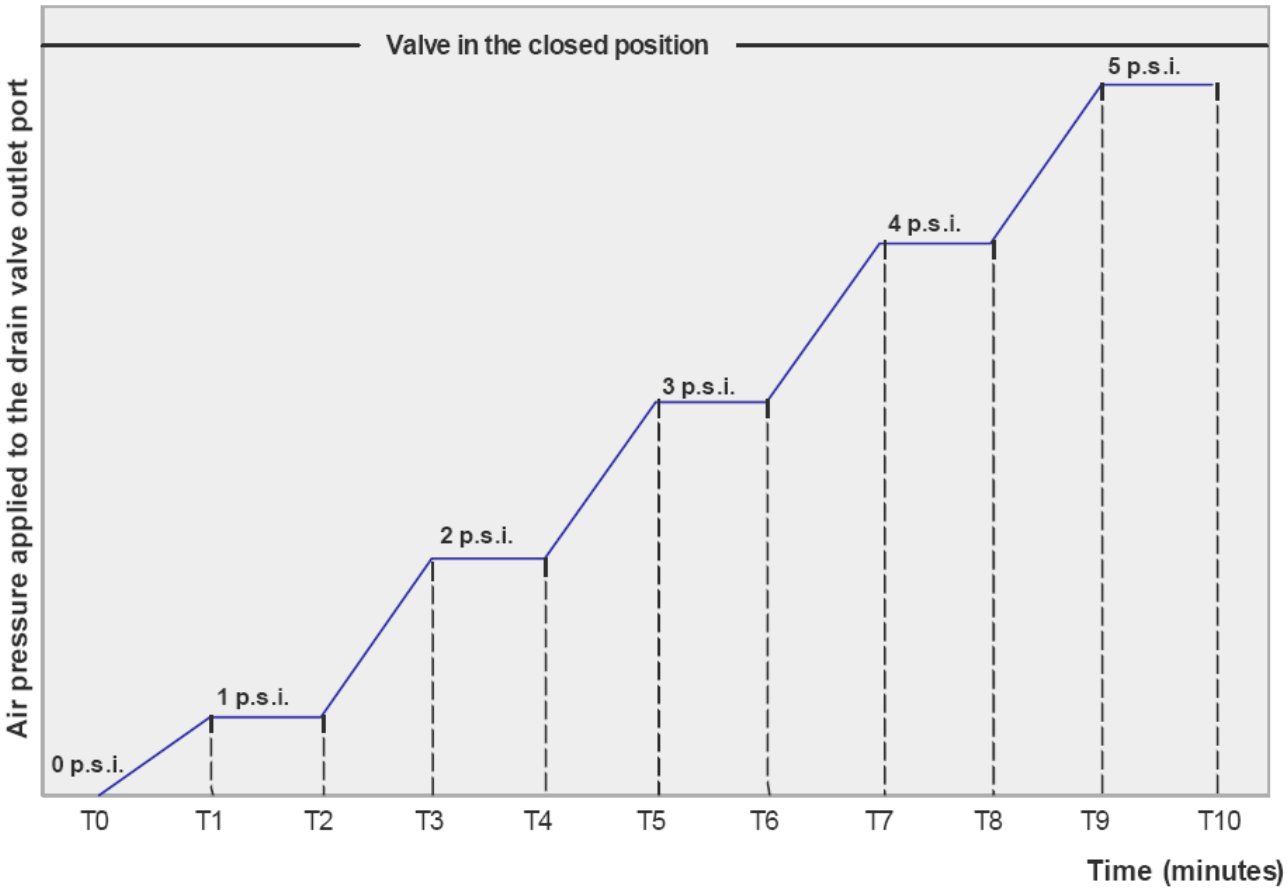
Tests	Paragraph 2 of this appendix	Samples
Functional	d.(1)	Valve 1
Flow Test	d.(2)	Valve 2
Fuel Leakage	d.(3)	Valve 3
Air Leakage	d.(3)	Valve 3
Fuel Resistance and Extreme Temperature	d.(4)	Valve 4
Resonance	d.(5)	Valve 5
Cycling	d.(5)	Valve 6
Proof Pressure	d.(6)	Valve 7
Fire Flammability Test	d.(7)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

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

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.

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***	Drain and blow dry, normal condition as expected under service conditions, ports open	Mount 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 or the normal operating temperature of the system where the component is used, whichever is higher	Circulating air at 158° ±2° F or the normal operating temperature of the system in which the component is used, whichever is higher ***Note 4***	Lower the fluid temperature to -67°±2° F, then maintain the fluid temperature at -67°±2° F for a minimum of 18 hours
Operation or tests during period	Actuate component at least 4 cycles per day in a normal manner ***Note 3***	None	None
Operation or tests immediately after period	Conduct leakage test, using *ASTM D471 Reference Fuel B	(a) Actuate components for 5 cycles. (b) Conduct functional and leakage tests 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, conduct functional and leakage tests in accordance with paragraphs 3.d.(1) and 3.d.(3) of this appendix, using *ASTM D471, Reference Fuel A

NOTES:
1. Follow each period immediately (45 minutes maximum) after the preceding one in the order noted.
2. Maintain the component to insure complete contact of all nonmetallic 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

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. Test the valve along three mutually perpendicular X, Y, and Z-axes; the X-axis lies along centerlines of the valve. 2. Uniformly increase the frequency time 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. Decrease the frequency so the complete cycle is accomplished in the specified cycle time.		