



Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, DC

TSO-C76a

Effective
Date: 02/16/07

Technical Standard Order

Subject: FUEL DRAIN VALVES

1. **PURPOSE.** This technical standard order (TSO) is for manufacturers of aircraft fuel drain valves applying for a TSO authorization (TSOA) or letter of design approval (LODA). In it, we (the Federal Aviation Administration, or FAA,) tell you what minimum performance standards (MPS) your fuel drain valves must 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 after the effective date of this TSO. However, we may do so up to six months after it, if we know that you were working against the earlier MPS before the new change became effective.

b. All fuel drain valve approved under a previous TSO authorization may still be manufactured under the provisions of their original approval.

c. Major design changes to a fuel drain valve approved under this TSO will require a new authorization. See Title 14 of the Code of Federal Regulations (14 CFR) § 21.611(b).

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 drain fuel or water from aircraft fuel tank sumps, fuel strainers, and gascolators.

b. **Failure Condition Classification.** Develop each fuel drain valve to at least the design assurance level equal to the failure condition classification of the aircraft system in which it is installed.

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

d. Environmental Qualification. Test the fuel drain valves according to the conditions specified in appendix 1 of this TSO and RTCA, Inc. document RTCA/DO-160E, *Environmental Conditions and Test Procedures for Airborne Equipment*, dated December 9, 2004, Section 26.

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 fuel drain valve maintains an equivalent level of safety. Apply for a deviation under 14 CFR § 21.609 before submitting your data package.

4. MARKING. Mark at least one major component permanently and legibly with all the information in 14 CFR § 21.607(d).

a. 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),
- (2) Each interchangeable element, and
- (3) Each article subassembly that you determined may be interchangeable.

b. If parts are too small to contain all the required information, mark them with the TSO number and the manufacturer's name or identifying mark. For such parts, place marking data required by 14 CFR § 21.607(d) on the shipping container of the part.

5. APPLICATION DATA REQUIREMENTS. As a TSO manufacturer-applicant, you must give the FAA's aircraft certification office (ACO) manager responsible for your facilities, a statement of conformance as specified in 14 CFR § 21.605(a)(1) and one copy each of the following technical data to support our design and production approval. (Under 14 CFR § 21.617(a)(2), LODA applicants submit the same data through their civil aviation authority:)

a. Operating instructions and limitations in an installation/instruction manual (IM), sufficient to describe the operational capability of the fuel drain valves. Describe any deviations in detail. If needed, identify equipment by part number, version, revision, and criticality level of software, classification for use, and environmental categories.

b. Installation procedures and limitations in an IM, sufficient to ensure that the fuel drain valves, when installed according to installation procedures, still meets this TSO's requirements. Limitations must identify any unique aspects of the installation. Finally, the limitations must include a note with the following statement:

The conditions and tests required for TSO approval of this fuel drain valve are minimum performance standards. Those installing this fuel drain valve on or in a specific type or class of aircraft, must determine that the aircraft installation conditions are within the

TSO standards. TSO articles must have separate approval for installation in an aircraft. The fuel drain valve may be installed only according to 14 CFR part 43 or the applicable airworthiness requirements.

- c. Schematic drawings of the installation procedures.
- d. Wiring diagrams of the installation procedures.
- e. List of components by part number that make up the fuel drain valve complying with the standards in this TSO. Include vendor part number cross-references, when applicable.
- f. A component maintenance manual (CMM), covering periodic maintenance, calibration and repair, for the continued airworthiness of installed fuel drain valves. Instructions should include recommended inspection intervals and service life. Describe the details of deviations granted, as noted in paragraph 5.a of this TSO.
- g. Material and process specifications list.
- h. The quality control system (QCS) description required by 14 CFR §§ 21.143 and 21.605(a)(3), including functional test specifications. The QCS should ensure that you will detect any change to the equipment that could adversely affect compliance with the TSO MPS, and reject the item accordingly. (Not required for LODA applicants.)
- i. Manufacturer's TSO qualification test report.
- j. Nameplate drawing with the information required in paragraph 4 of this TSO.
- k. List all drawings and processes (including revision level) to define the fuel drain valve's design. For a minor change, follow the directions in 14 CFR § 21.611(a). Show any revisions to the drawing list only on our request.
- l. An environmental qualifications form as described appendix 1 of this TSO.

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

- a. Functional qualification specifications to be used for qualifying each production article to ensure compliance with this TSO.
- b. Equipment calibration procedures.
- c. Corrective maintenance procedures within 12 months after TSOA or LODA.
- d. Schematic drawings.
- e. Wiring diagrams.

- f. Material and process specifications.
- g. Results of qualification tests conducted in accordance with appendix 1 of this TSO.

7. FURNISHED DATA REQUIREMENTS. If furnishing one or more fuel drain valves manufactured under this TSO to one entity (such as an operator or repair station), send one copy of the data and information specified in paragraphs **5.a** through **5.h** of this TSO. Add any other data needed for the proper installation, certification, use, or for continued airworthiness of the fuel drain valves.

8. HOW TO GET REFERENCED DOCUMENTS.

a. 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 through the SAE website at www.sae.org.

b. Order RTCA documents from RTCA Inc., 1828 L Street NW, Suite 805, Washington, D.C. 20036. Telephone (202) 833-0330, fax (202) 833-9434. You can also order copies on the RTCA website at www.rtca.org.

c. Order copies of 14 CFR parts from the Superintendent of Documents, Government Printing Office, P.O. Box 37154, Pittsburgh, PA 15250-7954. You can order copies through the Government Printing Office website at www.access.gpo.gov. Select "Access," then "Online Bookstore." Select "Aviation," then scroll to "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 www.airweb.faa.gov/rgl. You will also find the TSO Index of Articles at the same site.

e. Order ASTM documents from American Society for Testing of Materials, International, 100 Barr Harbor Dr., P.O. Box C700, West Conshohocken, PA 19428-2859. You can also order copies through the ASTM website at www.astm.org.

/s/ Susan J. M. Cabler

Susan J. M. Cabler
Acting Manager, Aircraft Engineering Division
Aircraft Certification Service

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

1. **PURPOSE.** This appendix explains the minimum performance standards (MPS) for fuel drain valves as modified by the FAA for this TSO. You may enhance the performance of specific equipment, or make it superior to this specification, depending on your intended application and configuration.

2. **GENERAL REQUIREMENTS.**

a. Materials.

- Use high quality materials that are suitable for use with aviation fuels having an aromatic content from 0 to 30 percent.
- Use synthetic rubber parts age dated in accordance with SAE International's Aerospace Recommended Practice (ARP) 5316B, *Storage of Elastomer Seals and Seal Assemblies Which Include an Elastomer Element Prior to Hardware Assembly*, dated November 11, 2002.
- Construct the fuel drain valve with corrosion resisting metals or metals protected to resist corrosion during the normal service life of the valve.
- 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.

(2) Position Indication.

- Provide an indication for the open and closed position of valves.
- Use a legend for position indication marking.
- Use detents or other suitable means to keep the valve in the full-closed position.
- 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.

APPENDIX 1. MPS FOR FUEL DRAIN VALVES (Continued)

(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.

- Design fuel drain valves to prevent the loss of parts.
- 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.
- 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, allow for the variation from specified conditions.

(2) Fluids. Unless otherwise specified, 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 2.b.(1) through 2.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.

APPENDIX 1. MPS FOR FUEL DRAIN VALVES (Continued)

- **Fuel Leakage.** Conduct the fuel leakage test at pressures of four inches of fuel, 1 p.s.i. +/- 0.1 p.s.i., 20 p.s.i. +/- 2 p.s.i., and 60 p.s.i. +/- 6 p.s.i. Apply the pressure to the drain valve inlet with the valve in the closed position. The fuel drain valve must not leak any fuel. See Figure 1 for test profile.

- **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 to five (5) p.s.i. 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. 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.**

- **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.

- **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**.

(6) **Proof Pressure.**

- With the valve in the closed position, apply a fuel pressure of 100 ± 2 p.s.i. for one minute at the inlet port, with the outlet port open to atmospheric pressure.

- 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 p.s.i. 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)**

APPENDIX 1. MPS FOR FUEL DRAIN VALVES (Continued)

Dry Test. Dry the valve in an oven at $158^{\circ} \pm 2^{\circ}$ F for four hours. Then subject the valve to 2,000 complete cycles of operation in the dry condition.

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.

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

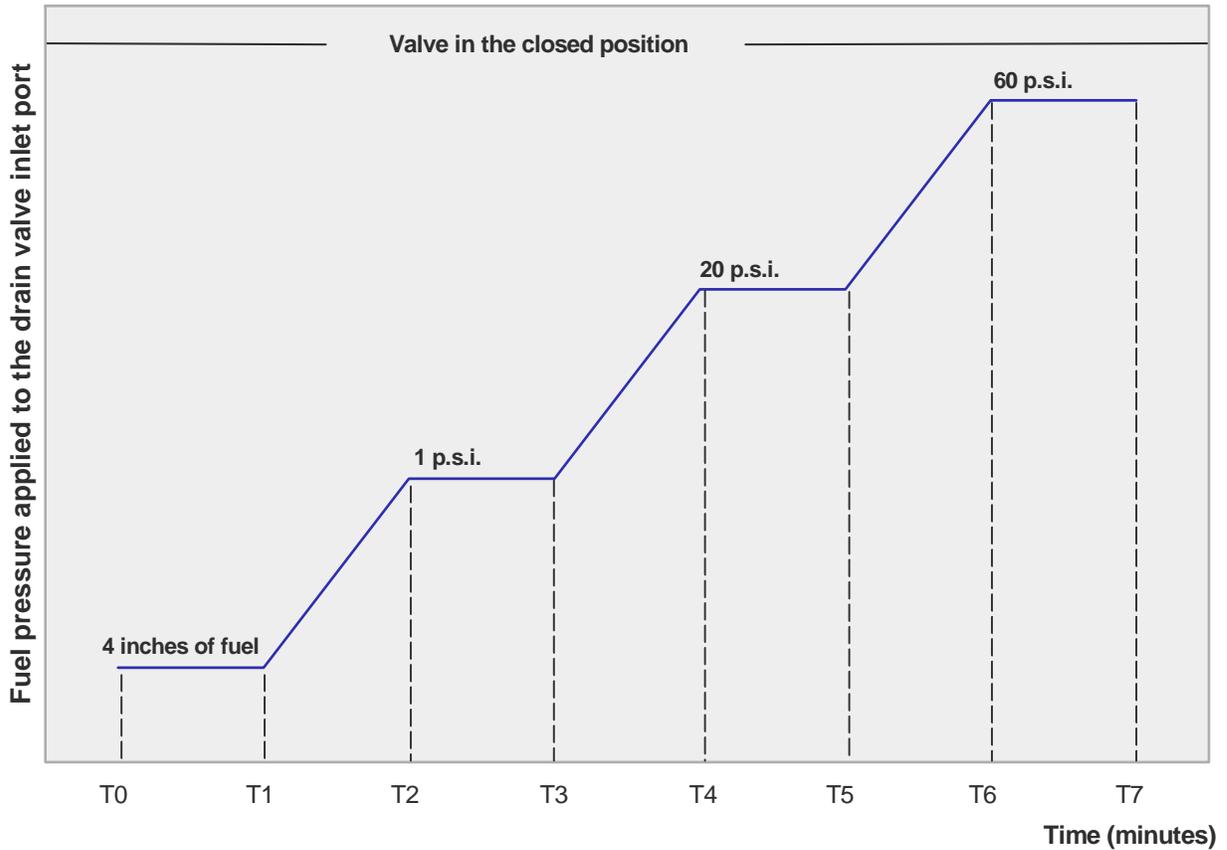
e. Test Samples.

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

APPENDIX 1. MPS FOR FUEL DRAIN VALVES (Continued)

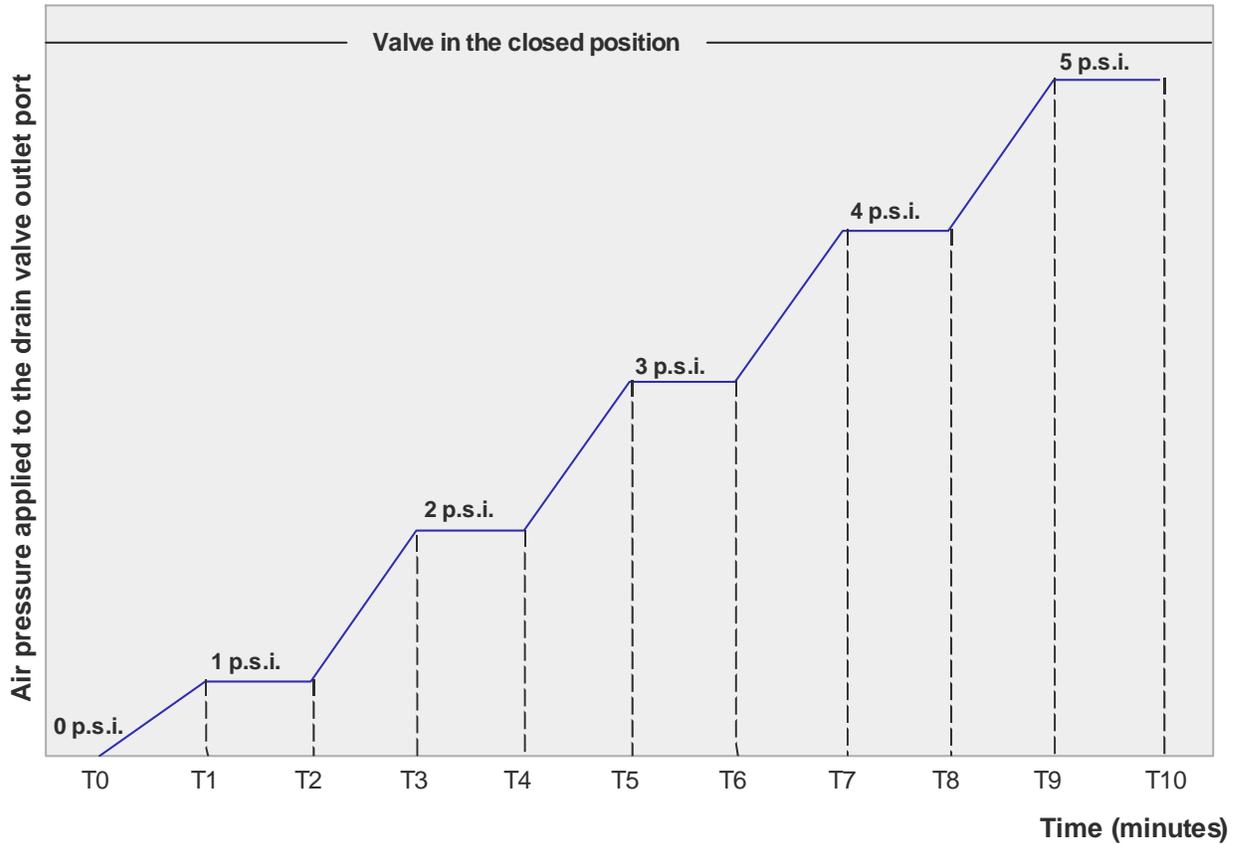
Figure 1 – Fuel Leakage Test



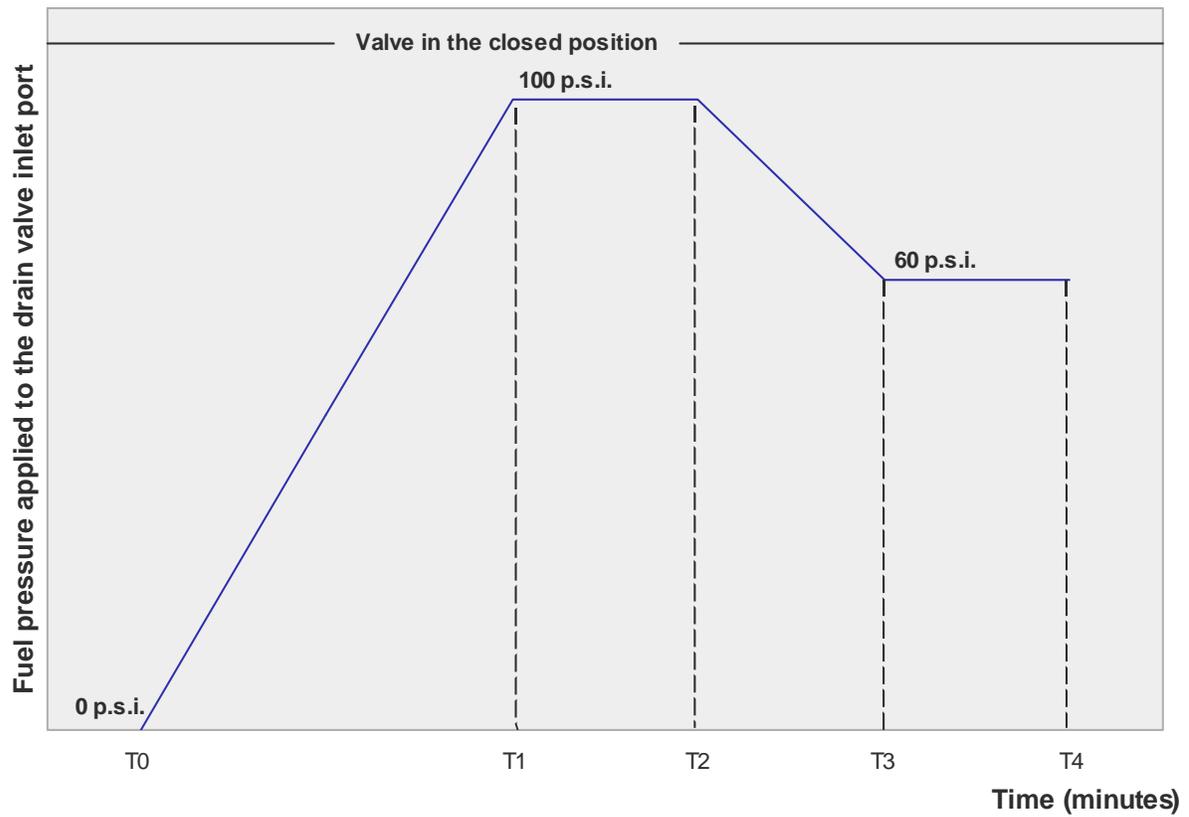
- NOTES:
- T0 to T1 -- 1 minute, minimum.
 - T1 to T2 -- no time restriction.
 - T2 to T3 -- 1 minute, minimum.
 - T3 to T4 -- no time restriction.
 - T4 to T5 -- 1 minute, minimum.
 - T5 to T6 -- no time restriction.
 - T6 to T7 -- 1 minute, minimum.
 - T7 -- end of test.

APPENDIX 1. MPS FOR FUEL DRAIN VALVES (Continued)

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.

APPENDIX 1. MPS FOR FUEL DRAIN VALVES (Continued)**Figure 3 – Proof Pressure Test**

- NOTES:
- T_0 to T_1 -- no time restriction.
 - T_1 to T_2 -- 1 minute, minimum.
 - T_2 to T_3 -- no time restriction.
 - T_3 to T_4 -- 30 seconds, minimum.
 - T_4 -- end of test.

APPENDIX 1. MPS FOR FUEL DRAIN VALVES (Continued)**Table 2 -Fuel Resistance and Extreme Temperature Test Schedule**

Test	Fuel Resistance		
Period <i>Note 1</i>	Phase I Soak	Phase I Dry	Low Temperature
Component configuration	<i>Note 2</i>	Drain and blow dry, normal condition as expected under service conditions, ports open	Mount as expected under normal service conditions <i>Note 2</i>
Test Fluid	*ASTM D471 Reference Fuel B	None	*ASTM D471 Reference Fuel A
Period duration	96 hours (4 days) <i>Note 3</i>	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 <i>Note 3</i>	Circulating air at 158° ±2° F or the normal operating temperature of the system in which the component is used, whichever is higher <i>Note 5</i>	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 <i>Note 4</i>	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 2.d.(1) and 2.d.(3) of this appendix, using *ASTM D471, Reference Fuel A <i>Note 4</i>	With temperature not higher than -65° F, conduct functional and leakage tests in accordance with paragraphs 2.d.(1) and 2.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. In 4 hours of the specified 96 hours, test the fuel drain valve at 185° ±2° F instead of 158° ±2° F.
4. There is no restriction in the actuation of the valve.
5. There is no restriction in the circulating velocity of air or mass flow.

* ASTM: American Society for Testing of Materials, International

APPENDIX 1. MPS FOR FUEL DRAIN VALVES (Continued)**Table 3 - Vibration Test**

Scanning cycle test	1	2	3
Axis of vibration	X	Y	Z
Fluid pressure	60 p.s.i. +/- 2 p.s.i.	60 p.s.i. +/- 2 p.s.i.	60 p.s.i. +/- 2 p.s.i.
Scanning cycle time	15 min.	15 min.	15 min.
Number of scanning cycles per test	2	2	2
Procedure	<ol style="list-style-type: none"> 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 $\pm 10g$. 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. 		

Vibration Test notes:

- Test at pressures of $\frac{1}{2}$ p.s.i. +/- 0.1 p.s.i. and five p.s.i. +/- 0.5 p.s.i. There cannot be any fluid leaking during the test.
- Test with air pressure varying successively from 0 - 5 p.s.i. gauge at the outlet port. Air leakage cannot exceed 10 cc. per minute of free air during the five p.s.i. air suction test.
- The valve cannot have damaged or loose parts as a result of the test.