

**Clearance Record  
DOCUMENT COMMENT LOG**

<b>Originating Office:</b> AIR-120 Jim Kabbara	<b>Document Description:</b> TSO-76b Fuel Drain Valves	<b>Project Lead/Reviewer</b>	<b>Reviewing Office:</b>	<b>Date of Review:</b> 2 Jul 10
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<b>Commenter</b>	<b>Page &amp; Paragraph</b>	<b>Comment</b>	<b>Reason for Comment</b>	<b>Suggested Change</b>	<b>Comment Resolution</b>
Shepherd ACE-100 2 Jul 10	Page 1, Para 1.	Change "Federal Aviation Administration, or FAA"... to "Federal Aviation Administration (FAA)," ...	FAA is an acronym similar to the others identified in the same paragraph. "Or" implies separate organization or entity.		Comment is accepted. Correction is made as suggested.
Shepherd ACE-100 2 Jul 10	Page 1, Para. 2	Change "six months after it," to "six months after the effective date"	clarity		Comment is accepted. Correction is made as suggested.
Wechsler ACE-100 2 Jul 10	Page 1, paragraph 2.a.	The second sentence of the paragraph, "Generally, we will not accept applications after the effective date of this TSO," needs to be a little more specific.	The sentence implies the FAA will not accept <b>ANY</b> applications after the effective date of this TSO.	Change the sentence to read, "Generally, we will not accept applications for prior TSO revisions after the effective date of the latest TSO revision."	Comment is accepted. The underlined words ( "Generally, we will not accept application <u>for prior TSO revision</u> after...") are incorporated in the paragraph 2.a
Shepherd ACE-100 2 Jul 10	Page 2, Para 3.g.	Change "We have provisions for using..." to "14 CFR 21.618 provides..."	Stating what the provision is specifically first reduces confusion.		The comment is not accepted. The wordings of paragraph 3.g (Deviations) are based on the existing TSO Template.
ACE-118C T. Smyth 2 Jul 10	Page 2, Paragraph 5(a)	Application Data Requirements, Line 3: Suggest (Remove) callout "criticality level of software" or (Add) "if applicable".			Comment is accepted. Correction is made as suggested.
ACE-118C T. Smyth 2 Jul 10	Page 3, Paragraph 5(1), Line 2	Suggest (Remove) callout for "Software" or (Add) "if applicable".			Comment is accepted. Correction is made as suggested.

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Shepherd ACE-100 2 Jul 10	Page 6, Para 1.	Change “for fuel drain valves as modified by the FAA...” to “for modified fuel drain valves as approved by the FAA...”	The FAA does not modify the component we approve the modification/ modification process.		We agree with your comment reason that FAA does not modify components but rather FAA approves modification of a component. The word “as modified by FAA” was meant for the modification of the drain valve MPS. To prevent such interpretation to the quoted statement, paragraph 1 is rewritten.
Shepherd ACE-100 2 Jul 10	Page 6, Para 1.	Second sentence addressing performance enhancement, what about limits exceedance on parts being addressed?			The comment is addressed in the same sentence. The applicant may elect to exceed the Fuel drain valve MPS. The applicant has to receive the final approval from reviewing ACO
Shepherd ACE-100 2 Jul 10	Page 7, Para 2.b.(6)c.(1)	How much variation is or will be allowed from the specified conditions?	Allows for too much ambiguity I believe.		The intent of the sentence is to address the atmospheric conditions other than the one listed in the paragraph. It is a reminder to account for any variation due the test setup. To remove any ambiguity, the sentence is changed to “When testing..... from these values, account for variation due to the test setup.”
Shepherd ACE-100 2 Jul 10	Page 7, Para 2.d.(3)	First sentence should be clarified. Is it 3 runs at 1, 20 and 60 psi with 4 inches of fuel and air pressure per figure 1 or something different.	Confusing		The test consists of three tests run in series. Figure 1 is updated to show the sequence of the three tests.
Shepherd ACE-100 2 Jul 10	Page 7, Para 2.d.(3)	Add a period to end of last sentence second bullet.			Comment is accepted. A period is added at the end of the paragraph.
Shepherd ACE-100 2 Jul 10	Page 9	Why not group Figures and tables together in the appendix?			Comment partially accepted. Figures and tables are generally grouped in final version.

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Chris Alfano ANE-171 7 Jul 10	Pg. 14 <b>Vibration Test</b> notes:	Suggest changing the unit display of “½ psi +/-0.1 psi and <b>five</b> psi. +/- 0.5 psi” to the engineering unit of “ <b>0.5</b> +/- 0.1 psi and <b>5.0</b> +/- 0.5 psi”.	Less confusing to reader.	<ul style="list-style-type: none"> <li>Test at pressures of 0.5 +/- 0.1 psi and 5.0 +/- 0.5 psi. There cannot be any fluid leaking during the test.</li> </ul>	Comment is accepted and incorporated.
Chris Alfano ANE-171 7 Jul 10	Pg. 14 <b>Vibration Test</b> notes:	Suggest changing “from <b>0 - 5</b> psi gauge at the outlet port. Air leakage cannot exceed 10 cc. per minute of free air during the <b>five</b> psi air suction test” to “from <b>0 to 5</b> psi gauge at the outlet port. Air leakage cannot exceed 10 cc. per minute of free air during the <b>5.0</b> psi air suction test”	Less confusing to reader.	<ul style="list-style-type: none"> <li>Test with air pressure varying successively from 0.0 to 5.0 psi gauge at the outlet port. Air leakage cannot exceed 10 cc. per minute of free air during the 5.0 psi air suction test.</li> </ul>	Comment is accepted and incorporated.
Chris Alfano ANE-171 7 Jul 10	Pg. 13 Appendix 1, <b>Table 2 -Fuel Resistance and Extreme Temperature Test Schedule</b>	What does note 3 deleted refer to in the tables?	Having note 3 “deleted” in the table may lead reader to believe testing is no longer required.	Suggest removing note: 3 from table.	Comment is accepted and incorporated.
Chris Alfano ANE-171 7 Jul 10	Pg 7. para 2.d(3) Leakage Test: Fuel Leakage	Request defining “must not leak any fuel” and where leakage would result.	Is leakage referred to internal or external fuel leakage? Define “not leak any fuel”, Is any seepage or drops allowable? If so how many?	Request stating “the fuel drain valve must not leak any fuel from valve discharge or outlet port.”	Comment is accepted and incorporated.
Chris Alfano ANE-171 7 Jul 10	Pg 7. para 2.d(3) Leakage Test: Air Leakage	Request defining “must not leak any air” and where leakage would result.	Is leakage referred to internal or external air leakage? Define “not leak any air”, Is any seepage or drops allowable? If so how many?	Request stating “the fuel drain valve must not leak any air from valve inlet port.”	Comment is accepted and incorporated.
James C. Lee ANE-173 7 Jul 10	Pg 2. para 3.g Deviations	Paragraph “3.g” order is incorrect. It should be “3.e”.	Paragraph “3.e” was skipped.	Request paragraph “3.g” is changed to “3.e”.	Comment is accepted and incorporated.

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James C. Lee ANE-173 7 Jul 10	Pg 3. para 5.f through 5o	Paragraph "5.f" through "5.o" order is incorrect. "5.f" should be "5.e" and so on.	Paragraph "5.e" was skipped.	Request paragraph "5.f" through "5.o" is changed "5.e" and so on.	Comment is accepted and incorporated.
James C. Lee ANE-173 7 Jul 10	Pg 2. para 5.	Paragraph refers to section "5.h" however "5.h" will be changed to "5.g"	Paragraph "5.h" will be changed to "5.g".	Request paragraph "5.h" is changed to "5.g".	Comment is accepted and incorporated.
James C. Lee ANE-173 7 Jul 10	Pg 4. para 5.o(3), 5.o(4), & 5.o(6)	Paragraph refers to section "5.o(1)" however "5.o(1)" will be changed to "5.l(1)"	Paragraph "5.o(1)" will be changed to "5.l(1)".	Request paragraph "5.o(1)" be changed to "5.l(1)".	Comment is accepted and incorporated.
James C. Lee ANE-173 7 Jul 10	Pg 4. para 6.f & 6.g	Paragraph "6.f" and "6.g" order are incorrect. "6.f" should be "6.e" and so on.	Paragraph "6.e" was skipped.	Request paragraph "6.f" and "6.g" is changed "5.e" and so on.	Comment is accepted and incorporated.
James C. Lee ANE-173	Pg 4. para 7.a & 7.b	Paragraph refers to section 5f, 5l, 5.o(1), & 5.o(4), however sections will be changed.	Paragraph reference should be change for corrections	Request the following paragraph change: "5f" to "5.e" "5l" to "5.k" "5.o(1) to "5.l(1)" "5.o(4) to "5.l(4)"	Comment is accepted and incorporated.
Rao Edupuganti ASW-100 7 Jul 10	Page. 6 of TSO. Para. B. Design and Construction	Include the temperature limits in which this valve operates. For example, 160°F to - 69°F of the fuel temperature	This should be one of the main design requirements. The important factor is that the seal material should be compatible with the fuel at this temperature and be able to plug the drain port without leak	Include temperature range in paragraph B. Design and construction.	Comment is not incorporated. The operating temperature range is left to end user to define depending on TC or STC.
Rao Edupuganti ASW-100 7 Jul 10	Page. 13 Table 2. 5 <sup>th</sup> row end and 3 <sup>rd</sup> columns	There is no need to say "or the normal operating temperature of the system where the component is used, whichever is higher"	TSO establishes minimum standards. The TSO item or parts may be used on different systems. The manufacturer of TSO article is generally aware of all the systems normal operating temperatures, in which this article is going to be used.	Delete "or the normal operating temperature of the system where the component is used, whichever is higher"	Comment is not incorporated. The operating temperature may be higher than the TSO call-out.

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AIR-130	Clearance Record – “Summary”  Signature page	TSO is acceptable, However some minor typographical Errors. The summary text is confusing; Is the new test value 185° +/- 2 °F or 158 ° +/- 2 °F. The second sentence opposes the first. Are we deleting the table text or the notes text (Bottom of document)	The Clearance Record Summary text is unclear and inconsistent with TSO Appendix 1 table 2 and page 8, ‘Reliability Tests’.	Do not delete the table text, but revise it to provide the correct test temperature (185° +/- 2 °F or 158 ° +/- 2 °F) which ever is correct. Also is it normal component actuation at 4 hour intervals or 4 cycles within 96 hours?	Comment is accepted. The Clearance Record – “Summary” is revised.  The summary is not inconsistent with page 8, “Reliability Test”.  The temp value, 185’ +/- 2 is not correct and went beyond the O-Ring material allowable.
AIR-130	Page 2 Para 3 d	Note below Para 3d as: per new TSO Template was omitted	to match TSO template	Add the following:  <b>NOTE:</b> Although no specific version of RTCA DO-160 environmental conditions and test procedures are specified, use of RTCA/DO-160D (with Changes 1 and 2 only, incorporated) or earlier versions will require substantiation via the deviation process as discussed in paragraph 3g of this TSO.	Comment is not applicable to this TSO since testing/qualification is not done per RTCA/Do-160D or any other DO-160 revisions
Adriana Rupert, AIR-103 (R. Bean)	Page 2; Paragraph 4.a.	We believe that 14 CFR § 45.15(b), Marking requirements for PMA articles, TSO articles, and Critical parts.	14 CFR § 21.616(d) includes 14 CFR part 45 in the text, but providing the reader with the correct and complete rule citation will be beneficial.		Comment is accepted. Revert back to 14 CFR § 21.603 since the requirement set by 14 CFR § 21.616(d) includes 14 CFR part 45 will not take effect until next year.
Adriana Rupert, AIR-103 (R. Bean)	Page 4; Paragraphs 5.o.(3), (4), and (6), plus 7.b.	Revise the sub-paragraph identification from “5o(1)” to “5.o.(1)”, and from “5o(4)” to “5.o.(4)”.			Comment is accepted. Corrections are made accordingly.

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Adriana Rupert, AIR-103 (R. Bean)	Page 4; Paragraph 6.b.	We believe that the time period for issuing the corrective maintenance procedures should be defined more specifically.		We suggest the following changes: "... 12 months after issuance of the TSOA ...)."	Comment is accepted. Revision of page 4, paragraph. 6. c. is made per the commenter recommendation.
Adriana Rupert, AIR-103 (R. Bean)	Page 4; Paragraph 7.a.	We suggest revising the first sentence to make it more succinct.		We recommend the following change: "... to the data identified/specified in paragraphs ...."	Comment is accepted. Revision of page 4, paragraph. 7. a. is made per the commenter's recommendation.
Adriana Rupert, AIR-103 (R. Bean)	Page 5; Signature	Un-italicize "David Hempe", and revise to read "David W. Hempe."			Comment is accepted. Revision of page 4, paragraph. 7. a. is made per the commenter's recommendation.
Adriana Rupert, AIR-103 (R. Bean)	Page 7; Appendix 1. Paragraph 2.c.(1)	At the end of the first sentence there seems to be an extra "d".			Comment is accepted. There is no extra 'd'. It should have been separate paragraph. Correction is made.
	Page 9; Appendix 1; Table 1	We note that there is no reference to Table 1 in the text, should there be a reference to the Table?			Comment is accepted. A reference to table one is added to paragraph 1.0 of the Appendix.
ANM-100	General	This TSO is identified as revision b, however, there are no revision marks to indicate what was changed relative to the existing TSO. As a result, the following comments may be on the unchanged areas.	Reviewers like to focus on the new areas of a revised document. Without revision marks, a reviewer cannot tell where to focus his/her attention.	Re-issue the comment suspense with a version of the TSO showing revisions.	Clearing Record provided summary of the changes made 1) Table 2 – Deleting note 3 2) Reformat the TSO to the new TSO Template. No change were made to the content of the TSO.
ANM-100	Page 1, paragraph 3.b. Failure Condition Classification	Paragraph 3.a. describes the function of a fuel drain valve as being a device for draining fuel. Paragraph 3.b. defines failure of that function as	The valve does more than simply provide a drain point. The majority of the time its function is to retain fuel in the tank (not leak). Failure of the valve to retain fuel can lead to ground	Revise paragraph 3.b. to acknowledge that failure to retain fuel may be major or catastrophic, depending on the installation design.	Comment is accepted. Paragraph 3b is revised to "Failure of the function defined in paragraph 3a of this TSO depends on the installation location of the fuel drain valve on the

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		having a minor effect. Paragraph 3.a. does not mention that the vast majority of the time the function of the valve is to retain fuel in the tank. Paragraph 3.b. does not classify the effects of failure of the valve to retain fuel in the tank. Failure of the valve to retain fuel can be major or catastrophic.	fires or to fuel exhaustion and forced landing.		aircraft. Develop each fuel drain valve to at least the design assurance level of the installation requirement of the system on which fuel drain valve is (will be) installed.”
ANM-100	Page 2 Paragraph 5	There is no stated design provision for the valve for collecting or routing drained fuel.	Part 34 fuel venting requirements, may have an impact on this valves installation	Add reference to Part 34 Fuel Venting.	This Valve manually operated on the ground to drain the fuel in a container for water content testing Comment accepted a reference to part 34.11 is added to paragraph 5.
ANM-100	Page 6, Appendix 1, paragraph 2.a. Materials.  Appendix 1, paragraph d., Test Methods and Performance Requirements	<b>Materials:</b> Corrosion of fuel drain valves is a major problem since they are exposed to water most of their lives. The materials section discusses using corrosion resistant materials, but we did not see any test requirements in Appendix 1 that specifically test the corrosion resistance capability of the valves. Gallings/stripping of valves located in the lower surface is also a problem encountered at Boeing. This occurred when the valves were made with aluminum threads. If there are portions of the valve that are routinely removed during maintenance, the threads should be shown to be resistant to galling.	Important design considerations that should be added to the TSO.	Revise Appendix 1, paragraph 2.a., to add a requirement that threaded portions of the valve that will be routinely removed during maintenance should be shown to be resistant to galling.  Revise Appendix 1, paragraph d. to add a corrosion resistance test.	Comment is accepted. Requirement for galling resistant material is added to Appendix 1, paragraph 2.a

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ANM-100	Page 6, Appendix 1, Section 2. General Requirements	<b>Crash impact/leakage:</b> There are no requirements in the TSO for crash resistance of valves. Sump drain valves or any valve that enters the tank should be designed so that no portion extends below the tank surface, or if it does, it is self sealing if it is impacted. Manufacturers routinely locate sump drains in fairings and in some cases attach hoses to the valves. Fuel spillage during an accident should not occur if any portion of the valve that extends outside the tank surface is impacted.	A requirement to address crash impact fuel leakage is consistent with aircraft installation flammable fluid fire protection requirements to minimize sources of flammable fluid leakage that might result in ignition.	Add a paragraph to section 2, General Requirements, to require the valve to be designed so that no portion extends below the surface of the structure in which it is installed, or if it does, it is self sealing if that portion of the valve that extends below the surface breaks off.	We believe that the crash impact comment the suggested change made here are not applicable for this TSO. The impact test and the installation of the valve should be the responsibility of the user and it should be part of the TC/STC.
ANM-100	Page 6, Appendix 1, Section 2. General Requirements	<b>Post Crash Fires:</b> Valves should also be shown to be fire resistant (no leakage of fuel) when tested per AC20-135 or under the materials section aluminum should be called out as the material for the valve. If the valve is intended to be located in the lower portion of a fuel tank where it will always be covered in fuel, a fire resistance test could allow credit for the installed configuration.	A requirement for fire resistant valves is consistent with aircraft installation flammable fluid fire protection requirements to minimize sources of flammable fluid leakage that might result in ignition. Any such valve located within a designated fire zone must be fire resistant by regulation. We certainly would not want a nylon drain valve to be installed in a fuel tank and then have a post crash fire to melt the valve and release fuel.	Add a paragraph to Section 2, General Requirements, to require fuel drain valves to be fire resistant.	We believe that the crash impact comment the suggested change made here are not applicable for this TSO. To add this requirement is unnecessary burden on the manufacturing of the valve since this fire resistant requirement is dependent on the location where the valve installed. It is the responsibility of the airframe manufacturer to call out this requirement when its applicable to the aircraft design. This requirement should be part of the TC/STC.
ANM-100	Page 7, Appendix 1, Paragraph 2.c.(1) Atmospheric Conditions	This paragraph states, "When testing with atmospheric pressure or temperature different from these values, allow for the variation from specified conditions." This wording simply says the applicant's test procedure must allow for the deviation.	The specified atmospheric conditions already allow a very broad air pressure range and a moderately broad temperature range. Applicants should be able to meet those requirements. If they can't, the acceptability of the test conditions they used should be justified rather than simply allowed for in the test plan.	Change the words "allow for" to "justify," or something similar.	Comment is accepted. The statement is revised to read "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 deviating from the specified conditions."

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		The applicant should justify the suitability of any variation from the specified conditions.			
ANM-100	Page 7, Appendix 1, Section 2.d. Test Methods and Performance Requirements	<b>Freeze and thaw water cycle:</b> One of the harshest environments could be freezing water in the valve. There is no requirement for showing valve operation at low temperatures with water present or that there is no damage during freezing conditions. An O ring seal could be damaged if a valve is operated when the valve is frozen, but the fuel is near freezing, or the expansion of water during ice formation could crack or damage the valve. This should be a test condition.	Extreme cold temperatures (cold soak) has resulted in inoperative fuel valves in service, reference AD's 89-14-06 and 2010-13-11	Add a freeze and thaw water cycle test. The test should vary fuel valve temperatures between low and high temperature extremes for the environment for which the valve is intended to be installed and become installation limits for the valve.	Comment is not applicable to this TSO. Table 2 includes testing at extreme temperatures.
ANM-100	Page 7, Appendix 1, paragraph d., Test Methods and Performance Requirements	<b>Lightning:</b> Any drain valve should be shown to meet the conducted current and direct strike requirements from the latest standard for Zone 2 and 3 lightning protection standards. Valves can be installed in Zone 2 on the engine nacelle or behind the engines, and in Zone 3 locations on the wing. The latest SAE standards require components located in Zone 3 to meet a direct attachment stroke of 40 KVA and zone 2 has always had requirements. I would think we would want	Components located in lightning strike zones must meet current lightning protection standards.	Consider adding lightning current and direct attachment tests to the TSO testing identified in Appendix 1.	Comment is not applicable to this TSO. The lightning is not part of the fuel drain valves design requirement. The requirement for lightning is part of the TC and/or of STC.

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		all valves to be tested for lightning, but this may be very dependent on installation effects so it may be a part 25 certification issue that would not be included in the TSO. We suggest you consult with Greg Dunn of the TSS and Dave Walen, lightning protection CSTA, to determine if we should include a minimum TSO requirement on all valves.			
ANM-100	Page 7, Appendix 1, Paragraph 2.d.(2)	This paragraph sets a minimum flow requirement for the drain valve when it is open as part of the MPS. No limit on the maximum flow capability is stated. The safety risk due to the valve failing open could be limited (at least on aircraft with large fuel capacity) by setting a maximum flow rate allowed when the valve is open.	Large fuel leaks on the ground create a significant fire hazard. Large leaks in flight create a risk of fuel exhaustion and forced landing.	Include in the paragraph an appropriate maximum fuel flow limit for an open valve.	The fuel load and internal fuel pressure will keep the valve closed in-flight. It is the responsibility of the aircraft/operator technician to ensure that the valve is securely closed after on-ground fuel draining.
ANM-100	Page 10, Appendix 1, Figure 1	<b>Fuel Leakage Test</b> , Figure 1, Appendix 1, is the same as Figure 2, which is for the air leakage test. Figure 1 doses not match fluid leakage requirements of Appendix 1, paragraph 2.d.(3).	Appears wrong figure inserted.	Replace with the Figure 1 that represents match fluid leakage requirements of Appendix 1, paragraph 2.d.(3).	Comment is accepted. Figure one is replaced to match the requirement of Appendix 1, paragraph 2.d.(3).
ANM-100	Page 13, Appendix 1, Table 2 – Fuel Resistance and Extreme Temperature Test Schedule  Page 2, Section 5.b. Installation procedures and	<b>Maximum Temperature:</b> Where did the 158 degree dry air test come from? It seems like the valve requirements need to match the airplane design. If an airplane has higher operating temperatures, how could a valve meeting this TSO test be installed? A valve exposed to solar heating	Extreme temperature testing should be representative of the highest expected temperature that the valve may be exposed to as installed in an aircraft.	Revise Section 5 to clarify that the environmental extremes from Appendix 1 tests should be identified in the installation manual as installation limits.	Comment is not applicable to the design requirement of this TSO. The limitation of the valve application is based on the sealing material capability to withstand temperature extremes.

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	limitations	in hot ambient conditions could reach very high temperatures. A valve located in a fairing next to a warm component, such as an air conditioning pack, could also result in high valve temperature. Also, aerodynamic heating on a supersonic airplane could result in very high temperatures. Maximum tested temperature should be identified as an installation limit in the TSO. It is not clear from Section 5 of the TSO that this would be identified as an installation limit.			
E. Haight ASW111	Appendix 1, Table 2, Note 3	Disagree with lowering the 4 hour high temperature testing from 185F to 158F	A TSO is a Minimum Performance Specification. Lowering this standard could cause an installation evaluation to overlook this requirement which could result in leaked fuel which could produce an unsafe condition. As an example, see Special Condition SC23-239-SC for the Cessna 525C. This installation saw fuel temperatures above 200F.	Retain the comment in Appendix 1, Table 2, Note 3.	The recommendation was not incorporated. However, we believe that the addition of the requirement " <b>158° ±2° F or The normal operating temperature of the system where the component is used, whichever is higher</b> " in table 2 would require the applicant to test the valve to a higher fuel temperature if that temperature is higher than 158F(minimum fuel test temperature). The duration of the test at that higher temperature is 96hrs which is far more than the 4 recommended hours. Additionally, as an added safety precaution the added requirement

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					to design the valve to a "Fail-Closed" condition (Appendix Para. b(1) ) will ensure that leak of fuel would not occur.