

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Single Mission Fuel Isolation Valve (SMFIV)

PART NO.: 10201-0122-801 FM CODE: A04
(Alt. for BI109 and BI110,
Mandatory for BI111 and Subs.)

ITEM CODE: 20-01-10A REVISION: Basic

CRITICALITY CATEGORY: 1 REACTION TIME: Seconds

NO. REQUIRED: 2 DATE: April 1, 2001

CRITICAL PHASES: Final Countdown, Boost SUPERCEDES:

FMEA PAGE NO.: A-20I ANALYST: G. Hoskins/S. Finnegan

SHEET 1 OF 4 APPROVED: S. Parvathaneni

FAILURE MODE AND CAUSES: External leakage of hydrazine (System A and/or B) caused by:

- o Defective or damaged interface sealing surface
- o Manifold/coil housing static seals fail to seal
- o K-seal failure
- o Thread Failure
- o Improper Torque
- o Improperly lockwired
- o Contamination

FAILURE EFFECT SUMMARY: Fire and explosion will lead to loss of mission, vehicle and crew.

REDUNDANCY SCREENS AND MEASUREMENTS: N/A

RATIONALE FOR RETENTION:

A. DESIGN

- o The Fuel Isolation Valve is designed and qualified in accordance with end item specification 10SPC-0240. (All failure causes)
- o Designed to show no visual evidence of external liquid leakage with an internal pressure of zero to 430 psig. When tested with a mixture of ninety percent N₂ and ten percent He gases, leakage shall not exceed 1×10^{-4} sccs of He. (All failure causes)
- o Valve body is a Aluminum Alloy 6061-T6 or T651. (Defective or damaged sealing surface, Manifold/coil housing static seals fail to provide adequate seal)
- o Manifold is Titanium, Type 6AL-4V. (Defective or damaged sealing surface, Manifold/coil housing static seals fail to provide adequate seal)
- o Operating pressure is zero to 430 psig, proof pressure is 650 psig minimum and burst pressure is 1300 psig minimum. (All failure causes)
- o Material selection is per MSFC-SPEC-522A. (Material Defect)

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- o MS type ports are used for both inlet and outlet with teflon coated stainless steel K-seals between dynatube adapter fittings and ports. K-seals are compatible with the liquid hydrazine environment. (K-Seal failure and defective or damaged sealing surface)
- o The Aft Skirt area is purged with GN2 prior to APU start up, reducing the O2 concentration to less than four percent per OMRSD File II, Vol. 1, requirement number S00FMO.430. (All failure causes)
- o Qualification testing verified design requirements as reported in Moog Inc. Qualification Test Report MR T-10241. (All failure causes)
- o Threaded fittings are Cres A286 Corrosion Resistant Steel. (Thread failure)
- o Inlet and outlet fitting surfaces are cleaned and protected per 10PRC-0339. (Defective or damaged sealing surface)
- o All threaded fittings and connectors are torqued per engineering specifications and are lockwired per MS 33540 as applicable. (Thread failure, Improper torque, Improperly lockwired)
- o Fluid procurement is controlled by SE-S-0073. (Contamination)
- o Valve is cleaned and cleanliness maintained during assembly per 10PRC-0339. (Contamination)

B. TESTING

- o Acceptance test is performed per Moog Inc. ATP MR A-9480 on the flight articles at vendor's plant. This includes a Visual Examination, Proof Pressure to 650 + 50/-0 psig and external leakage $< 1 \times 10^{-4}$ sccs of Helium Tests, and Cleanliness Verification. (All failure causes)
- o Fuel system leak check is performed with helium to 430 to 480 psig, leaks in excess of 1×10^{-4} sccs are not acceptable per 10REQ-0021, para. 2.3.3.1. (All failure causes)
- o Hydrazine is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.1 and OMRSD File V, Vol. 1, requirement number B42AP0.010. (Contamination)
- o GN2 cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.2 and OMRSD File V, Vol. 1, requirement number B42AP0.012. (Contamination)
- o System pressure decay test is monitored per 10REQ-0021 para. 2.3.3.1.b for the fuel system prior to hot fire. (All failure causes)
- o Hotfire test is performed during hotfire operations to demonstrate proper function per 10REQ-0021, para. 2.3.16. (All failure causes)
- o Verification of FSM bottle pressure for hydrazine system pressure check per OMRSD File V, Vol. I, requirement number B42AP0.025. (All failure Causes)
- o GN2 (from MLP portable panels) is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board flight hardware per OMRSD File V, Vol. 1, Requirement Number B42AP0.012. (Contamination)
- o Helium is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.5. (Contamination)

The above referenced OMRSD testing is performed every flight.

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Supersedes:

DRD 1.4.2.1-b

C. INSPECTION

I. VENDOR RELATED INSPECTIONS

- o Verification that all sealing surfaces have been inspected and accepted by Moog for dimensional and surface finish requirements and no damage to surface by USA SRBE PQAR per SIP 1511. (Defective or damaged sealing surface)
- o Verification of data and supplier acceptance of the following by USA SRBE PQAR. (Defective or damaged sealing surface, thread failure)
 - EB Welding - SIP 1511.
 - Heat Treat/Annealing - SIP 1511.
 - Nickel Plate with co-deposited Teflon coating – SIP 1511.
- o Verification of inspection and acceptance by Moog of the following by USA SRBE PQAR. (Improper torque, defective or damaged sealing surface, thread failure, improperly lockwired)
 - O-rings and seals - SIP 1511.
 - Torqueing Operations - SIP 1511.
 - Safety Wiring/lockwiring - SIP 1511.
 - Internal Threaded Parts - SIP 1511.
 - Seal Surfaces - SIP 1511
- o Verification of requirements by USA SRBE PQAR, per SIP 1511. (All failure causes)
- o Witness acceptance testing of FIV in which measurements and/or readings are manually taken and/or recorded for the first two units in each test lot by USA SRBE PQAR per SIP 1511. Monitor all acceptance testing for all other units in each test lot. (All failure causes)
- o Perform post-ATP final inspection of unit (Ref. ATP MR-9480) by USA SRBE PQAR per SIP 1511. (Defective or damaged sealing surface)
- o Witness all qualification testing in which measurements and/or readings are manually taken and/or recorded by USA SRBE PQAR per SIP 1511. Monitor all other qualification testing activities by USA SRBE PQAR per SIP 1511. (All failure causes)
- o All surfaces exposed to Hydrazine media, and require cleanliness verification, have been inspected and accepted by Moog and verified by USA SRBE PQAR per SIP 1511. (Contamination)
- o Critical Processes/Inspections:

- Annealing (Coil Housing) per EP 3388	- Penetrant (Manifold) per EP 3254
- Passivation (Coil Housing) per EP 3204	- Heat Treat per EP 3233
- EB Welding (Valve Housing, Coil Housing, Manifold) per EP 3406	- Magnetic Particle Inspection EP 3565
- Eddy Current Inspection per EP 3812	- Chromic Anodized (Valve Housing) per MIL-A-8625, Type 1, Class 1

II. KSC RELATED REFURBISHMENT INSPECTIONS

- o N/A

III. KSC RELATED ASSEMBLY & OPERATIONS INSPECTIONS

- o Cleanliness of FIV and attach tubing and/or hoses is verified per 10REQ-0021, para. 2.3.0. (Contamination, Improper Torque)
- o Witness the torque applied to critical TVC components per 10REQ-0021, para. 2.1.4. (Improper torque) CN 043

- o Verify installation of lockwire as indicated by assembly drawing per 10REQ-0021, para. 2.1.4. (Improperly lockwired)
- o Fuel system leak check is performed per 10REQ-0021, para. 2.3.3.1. (All failure causes)
- o Proper function of TVC system is demonstrated during hotfire per 10REQ- 0021, para. 2.3.16. (All failure causes)
- o Post hotfire verification, including inspections and leak checks per 10REQ-0021, para. 2.3.16.4. (All failure causes)
- o Sealing surfaces are inspected prior to installation verifying no contaminant or obstruction exists per 10REQ-0021, para. 2.3.0. (Defective or damaged Sealing Surface)
- o Helium cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.5. (Contamination)
- o Hydrazine cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.1 and OMRSD File V, Vol. 1, requirement number B42AP0.010. (Contamination)
- o GN2 cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.2 and OMRSD File V, Vol. 1, requirement number B42AP0.012. (Contamination)
- o System pressure decay test is monitored per 10REQ-0021 para. 2.3.3.1.b for the fuel system prior to hot fire. (All failure causes)
- o Inspect TVC system in aft skirt for damage - no leaks, signs of rubbing or discoloration are allowed per 10REQ-0021 following low speed GN2 spin, para. 2.3.11.3 and high Speed GN2 spin, para. 2.3.15.5. (All failure causes)
- o GN2 (from MLP portable panels) is verified for cleanliness and composition (purity and particulate count) prior to introduction on-board hydrazine circuits per OMRSD File V, Vol. 1, requirement number B42AP0.012. (Contamination)
- o GN2 (from servicing cart) is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board hydrazine circuits per OMRSD File V, Vol. 1, requirement number B42AP0.012. (Contamination)
- o Hydrazine (from servicing cart) is verified for cleanliness and composition (purity and particulate count) are verified prior to introduction on-board hydrazine circuits per OMRSD File V, Vol. 1, requirement number B42AP0.010. (Contamination)
- o Verification of FSM bottle pressure for hydrazine system pressure check per File V, Vol. I, requirement number B42AP0.025. (All failure Causes)
- o TVC Couplings (Both SRB and GSE) are inspected prior to mating before transfer to SPC per 10 REQ-0021 para. 2.3 and after transfer to SPC they are inspected prior to mating per File V, Vol. I, requirement number B42GEN.070. (All failure Causes).

D. FAILURE HISTORY

- o Failure Histories may be obtained from the PRACA database.

E. OPERATIONAL USE

- o Not applicable to this failure mode.

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