

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Fuel Supply Module (FSM)

PART NO.: 1) Tank - 10203-0015-801 FM CODE:A02
2) Temperature Sensor -
10203-0017-801
10203-0017-802 (Alt)
3) Pressure Transducer
10400-0230-801
and

Fittings, Plug, Bleeder
MS24391J4L
MS24391S4L (Alt)

Fittings, Connector
10209-0031-801
10209-0033-801
10209-0040-801
10209-0042-801

K Seal
10209-0015-801
10209-0015-802

ITEM CODE: 20-01-02

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 1, 2001

CRITICAL PHASES: Final Countdown, Boost

SUPERCEDES: March 31, 2000

FMEA PAGE NO.: A-8

ANALYST: B. Snook/S. Parvathaneni

SHEET 1 OF 6

APPROVED: S. Parvathaneni

FAILURE MODE AND CAUSES: External leakage of Hydrazine (system A and/or B) at six FSM fittings or at pressure transducer caused by:

- o Improper Torque
- o Defective or damaged sealing surface
- o Thread Failure
- o Contamination
- o K-seal Failure
- o Improperly Lockwired

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

REDUNDANCY SCREENS AND MEASUREMENTS: N/A

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RATIONALE FOR RETENTION:

A. DESIGN

- o The Fuel Supply Module is designed and qualified in accordance with end item specification 10SPC-0049. (All failure causes)
- o The FSM is cryostretched at LH2 temperature after welding per 10SPC-0049. (Thread failure)
- o The FSM is designated a fracture critical item, therefore, its design and construction are regulated by a fracture control plan (ARDE Document QA41006-7). (Thread failure)
- o Development and qualification units (2) were subjected to actual burst test which occurred at 4150 psig and 4350 psig (S.F. 10). (Thread failure)
- 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 S00FM0.430. (All failure causes)
- o Ground Support Equipment (GSE) used to pressurize the fuel system has multiple relief valves set at 440 psig to inhibit overpressurization. (Thread failure, K-Seal failure)
- o Proper manufacturing, materials and assembly is verified by USA SRBE PQAR per SIP 1110. (Defective or damaged sealing surface and improper torque)
- o Boss Ports on three FSM welded bosses are fabricated to MS33649. (Thread failure)
- o Titanium dynatube fittings are utilized at the MS Boss Ports for tube connection. (Defective or damaged sealing surface)
- o Teflon coated 304 stainless steel K-seals are installed between the dynatube connectors and the MS Boss Ports for preventing leaks. (K-Seal failure)
- o Fluid procurement is controlled per SE-S-0073. (Contamination)
- o USA SRBE PQAR verifies that all threaded fittings and connectors are torqued per engineering specifications and lockwired per MS 33540. (Improperly lockwired)
- o Qualification Testing verified design requirements as reported in ARDE Qualification Test Report QA 41006-19. (All failure causes)

B. TESTING

- o Acceptance Test is performed per ARDE ATP QA 41006-06 on new hardware. This includes a visual examination, weight, preproof volume and proof pressure test, post proof volume with a load capacity of 31.5 ± 1.5 lb. of hydrazine, permanent volumetric expansion, external leakage $\leq 1 \times 10^{-4}$ SCCS of helium and precision cleaning. (All failure causes)

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- o During refurbishment and prior to reuse the FSM is flushed with alcohol and cleaned per 10PRC-0339 and proof tested as required in 10SPC-0131. (All failure causes)
- o A fuel system leak test is performed with 380 +/-10 psig helium per 10REQ-0021, para. 2.3.3.1. (All failure causes)
- o Hydrazine cleanliness and composition (purity and particulate count) are verified prior to introduction on-board the flight hardware per 10REQ -0021, para. 2.3.2.1 and OMRSD File V, Vol. 1, requirement number B42AP0.010. (Contamination)
- o Helium cleanliness and composition (purity and particulate count) are verified prior to introduction on-board the flight hardware per 10REQ -0021, para. 2.3.2.5. (Contamination)
- o GN2 cleanliness and composition (purity and particulate count) are verified prior to introduction on-board the flight hardware per 10REQ-0021, para. 2.3.2.2 and OMRSD File V, Vol. 1, requirement number B42AP0.012. (Contamination)
- o GN2 (from MLP portable panels) is verified for cleanliness and composition (purity and particulate count) prior to introduction on-board the flight hardware per OMRSD File V, Vol. 1, requirement number B42AP0.012. (Contamination)
- o Fuel circuit passivation is performed on a newly assembled system or when system integrity is invalidated for component replacement per 10REQ-0021, para. 2.3.7.3. (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 A hotfire Test demonstrates proper function of the TVC system per 10REQ-0021, para. 2.3.16. (All failure causes)
- o Verification of FSM bottle pressure for hydrazine system pressure check per File V, Vol. I, requirement number B42AP0.025. (All Failure Causes)

The above referenced OMRSD testing is performed every flight.

C. INSPECTION

I. VENDOR RELATED INSPECTIONS

- o All material certifications are verified by USA SRBE PQAR per SIP 1110. (Defective or damaged sealing surfaces)

- o Build records on each unit are verified per SIP 1110 by ARDE and USA SRBE.
- o K-seal sealing surfaces verified by USA SRBE PQAR per SIP 1110. (Defective or damaged sealing surface)
- o All ports are verified by USA SRBE PQAR per SIP 1110. (Defective or damaged sealing surfaces)
- o Dye penetrant and radiographic records are verified by USA SRBE PQAR per SIP 1110. (Defective or damaged sealing surface)
- o All acceptance testing (including cleanliness) is witnessed by USA SRBE PQAR per SIP 1110. (All failures)
- o Final visual Inspection of unit and data to drawing and specification requirements are verified by USA SRBE PQAR per SIP 1110. (All failure causes)
- o Flight units returned to ARDE for repair are reworked to the data package and acceptance test is verified by USA SRBE PQAR per SIP 1110. (All failure causes)
- o Critical Processes/Inspections:
 - o Welding per AES 551
 - o X-ray per AES 450
 - o Dye penetrant per AES 451
 - o Passivation per ME 10061

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II. KSC RELATED REFURBISHMENT INSPECTIONS

- o Visual inspection of FSM will be performed per 10SPC-0131, para. II. (All Failure Causes)
- o Functional testing of FSM will be performed per 10SPC-0131, paragraph IV.

All manual tests will be witnessed by Quality or verified for those instances when controlled software is utilized and a test report is generated. (All Failure Causes)

III. KSC RELATED ASSEMBLY AND OPERATION'S INSPECTION

- o Verification by USA SRBE of helium leak check after installation per 10REQ-0021, para. 2.3.3.1. (Contamination)
- o Precision cleaning of tubes/hoses is verified by USA SRBE per 10REQ-0021 para. 2.3.0. (Contamination)
- o K-Seals (as applicable) are inspected with 3X magnification for absence of physical defects (cuts, voids, creases, flashing or burrs) per 10REQ -0021, para. 2.3.0 prior to installation. (K-Seal failure)
- o Prior to installation sealing surfaces are inspected to verify that 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 on-board the flight hardware per 10REQ-0021, para. 2.3.2.5. (Contamination)
- o Hydrazine cleanliness and composition (purity and particulate count) are verified prior to its introduction on-board the flight hardware per 10REQ-0021, para. 2.3.2.1 and OMRSD File V, Vol. 1, requirement number B42APO.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 Inspection of 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 to 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) prior to introduction to on-board hydrazine circuits per OMRSD File V, Vol. 1, requirement number B42AP0.010. (Contamination)
- o TVC Couplings (Both SRB and GSE) are inspected each time prior to mating per 10REQ-0021 para. 2.3. After transfer to SPC they are inspected prior to mating per File V, Vol. I, requirement number B42GEN.070. (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 Installation of lockwire is verified as indicated on assembly drawing per 10REQ-0021, para. 2.1.4. (Improperly lockwired)
- o Proper torque applied to critical TVC components is witnessed per 10REQ-0021, para. 2.1.4. (Improperly lockwired)

- 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 are in accordance with 10REQ-0021, para. 2.3.16.4. (All failure causes)

D. FAILURE HISTORY

Criticality Category 1:

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

E. OPERATIONAL USE

- o Not applicable to this failure mode.