SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Fuel Supply Module (FSM)

PART NO.: 1) Tank - 10203-0015-801
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-Seals
10209-0015-801
10209-0015-802

FM CODE: A01

ITEM CODE: 20-01-02

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 1, 2001 CN 042

CRITICAL PHASES: Final Countdown, Boost

SUPERCEDES: March 31, 2000 CN 042

FMEA PAGE NO.: A-7

ANALYST: B. Snook/S. Parvathaneni

SHEET 1 OF 5

APPROVED: S. Parvathaneni

FAILURE MODE AND CAUSES: Rupture Caused By:

- Material Defect
- Manufacturing Defect

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

- The Fuel Supply Module is designed and qualified in accordance with end item specifications 10SPC-0049. (All failure causes)
- The FSM is a 300 series stainless steel welded assembly (85,000 lb/in tensile). (Manufacturing defects, Material Defects)
- Operating pressure is 0 to 430 psig, design proof pressure is 650 + 100/-0 psig (S.F. 1.5) and design burst is 1600 psig (S.F. 4.0). (Material defects, Manufacturing defects)
- The FSM is cryostretched at LH_2 temperature after welding. (Manufacturing defects)
- The FSM is designated a fracture critical item, therefore, its design and construction are regulated by a fracture control plan (ARDE Document QA 41006-7). (Manufacturing defects)
- Development and qualification units were subjected to actual burst, occurring at 4150 psig and 4350 psig (S.F. 10) respectively. (Material defects)
- The aft skirt area is purged with GN2 prior to APU start up, reducing the 02 concentration to less than four percent per OMRSD File II, Vol. 1 requirement number S00FM0.430. (All failure causes)
- Ground Support Equipment (GSE) used to pressurize the fuel system has multiple relief valves set at 440 psig cracking pressure. (Material defects)
- Material selection is per MSFC-SPEC-522A. (Material defects)
- Welded with 308L weld wire. (Manufacturing defects)
- Qualification testing verified design requirements as reported in ARDE Qualification Report QA 41006-19. (All failure causes)

B. TESTING

- Acceptance Test is performed per ARDE ATP QA 41006-06 on new hardware.This includes a visual examination, weight not in excess of 29 lbs., pre-proof volume of 1728 - 1900 in^3, proof pressure test to 650 psig, post proof volume of 1728 - 1900 in^3 with a load capacity of 31.5 ± 1.5 lb of hydrazine, permanent volumetric expansion 0.6 percent or less, external leakage $\leq 1 \times 10^{-4}$ SCCS of helium and precision cleaning. (All failure causes)

CN 042

- The FSM is penetrant tested during manufacturing per ARDE document AES 451. (Manufacturing defect)
- During refurbishment and prior to reuse, FSM is alcohol flushed and cleaned per 10PRC-0339 and proof tested as required in 10SPC-0131. (All failure causes)
- 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. (Material defect)
- Fuel system leak test is performed at 380 +0/-10 psig helium per 10REQ-0021, para. 2.3.3.1. (Material defect and manufacturing defect)
- 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. (Material defect)
- 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. (Material defect)
- 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. (Material defect)
- 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)
- Verification of FSM bottle pressure for hydrazine system pressure check per File V, Vol. I, requirement number B42AP0.025. (All Failure Causes)
- Hotfire test demonstrates proper function of the TVC system per 10REQ-0021, para. 2.3.16. (All failure causes)

The above referenced OMRSD testing is performed every flight.

C. INSPECTION

I. VENDOR RELATED INSPECTIONS

- All material certifications are verified by USA SRBE PQAR per SIP 1110. (Material defect)
- Verification of dye penetrant and radiographic records by USA SRBE PQAR per SIP 1110. (Manufacturing defect)

- o All acceptance testing including proof testing is witnessed by USA SRBE PQAR per SIP 1110. (All failure causes)

- o Final visual inspection by USA SRBE PQAR to drawing and specification requirements per SIP 1110. (Manufacturing defects)

- o Flight units returned for refurbishing are reworked with the data pack and acceptance test verified by USA SRBE PQAR per SIP 1110. (All failure causes)

- o Critical Processes/Inspections:

  - Welding per AES 551
  - Dye Penetrant per AES 451 CN 042
  - Heat Treating per AES 350/351
  - Cryogenic Forming per Proprietary Process
  - X-ray per AES 450
  - Passivation per ME 10061

  CN 042

II. KSC RELATED REFURBISHMENT INSPECTION

- 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 OPERATIONS INSPECTION

- o Precision cleaning of tubes/hoses is verified by USA SRBE per 10REQ-0021, para. 2.3.0. (Material defects)

- o O-Rings, K-Seals and E-Seals (as applicable) are inspected prior to installation for absence of physical defects per 10REQ-0021, para. 2.3.0 (Manufacturing defects)

- o Sealing surfaces are inspected prior to installation, verifying no contaminant or obstruction exists per 10REQ-0021, para. 2.3.0 (All failure causes)

- 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. (Material defect)

- o FSM connections pressure check acceptance by USA SRBE per 10REQ-0021, para. 2.3.6. (Material and Manufacturing Defect)

- o Fuel system leak test is performed with helium per 10REQ-0021, para. 2.3.3.1. (Material defect and manufacturing defect)

- 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. (Material defect)

- o GN2 cleanliness and composition (purity and particulate count) are verified prior to introduction onboard the flight hardware per 10REQ-0021, para. 2.3.2.2 and OMRSD File V, Vol. 1, requirement number B42AP0.012. (Material defect)

- 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 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 Proper function of TVC system is demonstrated during hotfire per 10REQ-0021, para. 2.3.16. (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. (Material defects)

- 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. (Material defect)

- 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. (Material defect)

- 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. (Material Defects).

- o Verification of FSM bottle pressure for hydrazine system pressure check per File V, Vol. I, requirement number B42AP0.025. (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.