

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Fuel Isolation Valve (FIV)

PART NO.: 10201-0052-801 (Effectivity BI062 thru BI081) FM CODE: A05
10201-0052-802 (BI082 & Subs Mand.,
Alternate until BI081)
10209-0042-801 (Fitting Connector)
10209-0015-802 (K-Seal)

ITEM CODE: 20-01-10

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 31, 2000

CRITICAL PHASES: Final Countdown, Boost

SUPERCEDES: March 31, 1997

FMEA PAGE NO.: A-20

ANALYST: B. Snook/ S. Parvathaneni

SHEET 1 OF 4

APPROVED: S. Parvathaneni

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FAILURE MODE AND CAUSES: Rupture caused by:

- o Material Defect
- o Manufacturing Defect
- o Internal leakage of hydrazine to the electrical components

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-0056. (All failure causes)
- o Design operating pressure is 430 psi, burst pressure 1600 psi. Actual burst occurred at 4000 psig. (All failure causes)
- o Valve will relieve outlet overpressure (exceeding 450-550 psi) to inlet, to equalize pressure differential. (Material defect)
- o Material selection is per MSFC-SPEC-522A, Cres 304L, Condition A. Cres 350 and Cres 355. (Material defect)
- 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 Valve is designed and is tested for 1000 cycles minimum life. (All Failure Causes)
- o Qualification testing verified design requirements as reported in Consolidated Controls Qualification Test Report 74740 QTR 1, Rev. A. (All failure causes)

B. TESTING

- o Acceptance testing is performed per Consolidated Controls Corp. ATP 74740 on the flight articles at vendor's plant. This includes Visual Examination, Proof Pressure to 650 + 50/-0 psig and external leakage $\leq 5 \times 10^{-6}$ sccs Helium Tests, Performance Checks, Closed Forward Check, Internal Leakage $\leq 5 \times 10^{-3}$ sccs Helium and Cleanliness Verification. (All failure causes)
- o Penetrant inspection is performed on welds during manufacturing per Consolidated Controls procedure S-3031A. (Manufacturing defect)
- o GSE used to pressurize the fuel system has multiple relief valves set at 440 psig. (All failure causes)
- o During refurbishment and prior to reuse, Fuel Isolation Valves are reworked per 10SPC-0131 and acceptance testing by USA SRBE/TBE Florida Operations per the criteria of 10SPC-0056. This includes visual examination, cleanliness verification, proof pressure to 675 ± 25 psig and external leakage $\leq 1 \times 10^{-4}$ sccs Helium Tests, internal leakage helium test, Performance Checks, Closed Forward Check. Internal leakage $\leq 5 \times 10^{-3}$ sccs helium. (All failure causes)
- o Fuel system leak check is performed with helium at 380 +0/-10 psig, verifying no leaks in excess of 1×10^{-6} sccs per 10REQ-0021, para. 2.3.3.1 (Manufacturing Defects)
- o Fuel circuit passivation verification is performed per 10REQ-0021, para. 2.3.7.3 on newly assembled systems and those whose integrity is invalidated for component replacement. (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 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 File V, Vol. I, requirement number B42AP0.025. (All Failure Causes)
- 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. (Material defect)
- o FIV internal cavity leakage testing is performed by consolidated controls per ATP 74740 and by USA SRBE/TBE Florida Operations per the CRITERIA of 10SPC-0056 at 675 ± 25 psig verifying no leaks in excess of 5×10^{-6} sccs/sec (Internal leakage of hydrazine to electrical components)

- 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. (Material defect)
- o APU Bite resistance test B42AP0.050 and Frequency Bite test B42AP0.060 per File V, Vol. I, at post hydrazine loading to L-24 hours and at T-9 hours, provides confidence that the coil assembly of the fuel isolation valve is not degraded by the exposure to hydrazine. (Internal Leakage of hydrazine to the electrical components.)

The above referenced OMRSD testing is performed every flight.

C. INSPECTION

I. VENDOR RELATED INSPECTIONS

- o Verification of identity, traceability and configuration by USA SRBE PQAR per SIP 1204. (Material defect)
- o Verification that all parts are inspected for proper materials, assembly, surface finish, burrs, damage and contamination by USA SRBE PQAR per SIP 1204. (Manufacturing defects)
- o Witness assembly and verify operation of valve by USA SRBE PQAR as below: (All failure causes)
 - Pressure Records - SIP 1204.
 - Torque - SIP 1204.
 - External Welds - SIP 1204
- o Perform final inspection to drawing requirements by USA SRBE PQAR per SIP 1204. (Material defect, manufacturing defect)
- o Refurbishment requirements at vendor's plant are verified by USA SRBE PQAR per SIP 1204. (All failure causes)
- o Witness acceptance testing of FIV by USA SRBE PQAR per SIP 1204. (All failure causes)
- o Critical Processes/Inspections:
 - Passivation of bellows per MIL-S-5002C (Alt. BI062 - BI081) or QQ-P-35 (Mandatory BI082 & Sub)
 - Fusion Welding (Bellow Assembly) per S-3012E
 - TIG Welding (poppet and shaft bellows assembly) per S-3015
 - EB Welding (poppet seat assembly) per S-3032
 - Penetrant per S-3031A
 - Heat Treat per QQ-S-763

II. KSC RELATED REFURBISHMENT INSPECTIONS

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

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III. KSC RELATED ASSEMBLY AND OPERATIONS INSPECTIONS

- o Fuel system leak check is performed per 10REQ-0021, para. 2.3.3.1. (Material defect, manufacturing defect)
- 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. (Material defect, manufacturing defect)
- 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. (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 Inspections 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. (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 Defect).
- 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 Verification of FSM bottle pressure for hydrazine system pressure check per File V, Vol. I, requirement number B42AP0.025. (All Failure Causes)

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D. FAILURE HISTORY

Criticality Category 1:

Failure histories may be obtained from the PRACA database.

E. OPERATIONAL USE

- o Not applicable to this failure mode