SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Servovalve Inlet Filter Assembly,
Part of Servoactuator

PART NO.: A22488-1(Filter & Sleeve Assembly),
A50656 (Element)

FM CODE: A02

ITEM CODE: 20-02-02

REVISION: 3

CRITICALITY CATEGORY: 1

REACTION TIME: Seconds

NO. REQUIRED: 2 (one per actuator)

DATE: March 1, 1996

CRITICAL PHASES: Boost

SUPERCEDES: March 1, 1993

FMEA PAGE NO.: A-185

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SHEET 1 OF 6

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FAILURE MODE AND CAUSES: Ineffective filtering caused by:

- Defective filter element
- Filter medium migration

FAILURE EFFECT SUMMARY: Contamination causing servovalves to fail leads to actuator going hardover. Loss of Thrust Vector Control will lead to vehicle breakup and loss of mission and crew.

RATIONALE FOR RETENTION:

A. DESIGN

- The Servovalve Inlet Filter Assembly is designed and qualified in accordance with end item specification 10SPC-0055.

- Material selection is in compliance with MSFC-SPEC-522A. (All Failure Causes)

- The filter is wire mesh constructed of CRES 304L, 316L, 321 or 347 material with end fittings welded to wire mesh element. The filter is supported by a sleeve to prevent sudden flow surges destroying the filter. The filter element is designed to withstand 3250 psi, differential, without collapsing. (All Failure Causes)

- The filter is designed to entrap nonsoluable contaminates of 10 micron nominal size and 15 microns absolute. The filter is sized for a service life of twenty flights without refurbishment. (All Failure Causes)

- Servoactuator cleaning and assembly operations are performed in a controlled environment conforming to Class 100,000 clean room. The clean room environment is certified per Moog QAP 803-001-100. The filter is cleaned in accordance with 10PRC-0620. (All Failure Causes)

- The filter is designed for removal, cleaning, and reuse. The filter assembly is interchangeable and traceable by filter element serial number. (All Failure Causes)

- The filter is designed to maximum pressure drops across the filter of not more than 25 psid at the design flow rate with a clean filter and not more than 100 psid with maximum design flow rate after the completion of the life duty cycle test per USBI Specification 10SPC-0055. (All Failure Causes)

- Fluid sampling valve ports are provided on the primary inlet and on the return side of the servoactuator. (All Failure Causes)

- The Servovalve Inlet Filter Assembly, as part of the servoactuator, was subjected to qualification testing which verified the design requirements, including a burst pressure conducted at Moog. The test results are reported in Qualification Test Report MSFC-RPT-900. The Moog conducted burst pressure testing results are reported in Moog Report No. MR T-2980. Two units were subjected to qualification testing. After completion of the MSFC/Moog conducted testing, the two units were torn down and inspected. There was no evidence of wear, damage or other anomalies as reported in Moog disassembly and inspection analysis reports, MR M-2982 and MR M-2983. (All Failure Causes)

- At the end of qualification testing, the filter was successfully subjected to a filter flow test. The report confirms the twenty mission qualification requirements. (All Failure Causes)

B. TESTING

VENDOR RELATED TESTING

- Servoactuator Acceptance Tests are performed per Moog Report MR A-2406. A fluid sampling valve is installed on the test unit return port. The test article is cycled at approximately fifty percent stroke and a 100 ml fluid sample is drawn in a pre-cleaned sample bottle in accordance with Moog Report MR A-2406. The sample is forwarded to Moog Quality Control Laboratory for contamination analysis. (All Failure Causes)

- A two minute flushing procedure is followed when a hydraulic line is removed or reinstalled according to Moog Report MR A-2406. (All Failure Causes)

- Refurbished servoactuators are tested as follows: (All Failure Causes)

  - End Item Acceptance Test per Moog MR A-2406. This is the same ATP as new hardware except some component level tests are not required

when teardown does not affect the validity of the previous component test. These component tests are Power Valve Pressure Gain, Transient Load Relief Valve, and Servovalve Differential Pressure Transducers.

KSC RELATED TESTING

- Helium is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board circuits per 10REQ-0021, para. 2.3.2.5.(All Failure Causes)

- Hydraulic fluid is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board Hydraulic circuits per 10REQ-0021, para. 2.3.2.6. (All Failure Causes)

- Effluent hydraulic fluid is verified for moisture content and cleanliness (water content and particulate count) from the rock actuator, the tilt reservoir, the rock reservoir and the tilt actuator per 10REQ-0021, para. 2.3.12.3. (All Failure Causes)

- Functional operation of the actuators is verified during hotfire per 10REQ-0021, para. 2.3.16.3. (All Failure Causes)

- Actuator null, linearity and polarity and servovalve redundancy verification tests are performed per 10REQ-0021, para. 2.3.14. (All Failure Causes)

- Hydraulic fluid is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board Hydraulic circuits during prelaunch operations per OMRSD File V, Vol. 1 Requirement Number B42HP0.010. (Contamination)

- Ascent Thrust Vector Control/SRB-TVC system response to predefined input commands per OMRSD File II, Vol. 1 Requirement Number S00000.650 (Gain Test). (All Failure Causes)

- Dynamic operation of the Ascent Thrust Vector Control/SRB-TVC System Failure Detection and Isolation Circuitry per OMRSD File II, Vol. 1 Requirement Numbers S00000.670 and .680 (Individual Channel Test). (All Failure Causes)

- Frequency response (gain and phase) and step response of the Ascent Thrust Vector Control/SRB-TVC system per OMRSD File II, Vol. 1 Requirement Numbers S00000.720 and .750 respectively (Frt/Step Response Test). (All Failure Causes)

- Gimbal test performed after SRB HPU start under control of automated software in Ground Launch Sequencer (GLS) and Redundant Set Launch

Sequencer (RSLS) verifies actuator performance by monitoring actuator position, servovalve differential pressure, isolation valve events and APU turbine speed (related to actuator pressure switch). Pass/fail criteria for automated portions of terminal countdown are controlled by OMRSD File II, Vol. 1, Requirement Number S00FS0.030 and launch commit criteria. This is the last test that verifies actuator performance. (All Failure Causes)

- The above referenced OMRSD testing is performed every flight.

C. INSPECTION

VENDOR RELATED INSPECTIONS

- USBI QAR witnesses final actuator ATP per USBI SIP 1127. (All Failure Causes)
- USBI QAR verifies hydraulic fluid is inspected for contamination before loading per SIP 1127. (All Failure Causes)
- USBI QAR verifies filter material, cleanliness and assembly certifications per SIP 1127. (All Failure Causes)
- USBI QAR verifies Moog data of inspection and test records from filter vendor per SIP 1127. (All Failure Causes)
- USBI QAR verifies traceability records per USBI SIP 1127. (All Failure Causes)
- During refurbishment and prior to reuse, the servoactuator is disassembled, cleaned, inspected and tested to ensure proper performance per 10SPC-0131. Preliminary evaluation includes: (All Failure Causes)
  - Clean and inspect external surfaces
  - Functional test
  - Disassembly as required to inspect the body/cylinder interface and bushing, spool and sleeve assemblies of the: selector valve, lock valve, servovalves, and power valve, for evidence of seawater contamination.
- Extent of repair is determined from this evaluation and accomplished per the following general requirements. (All Failure Causes)
  - Total disassembly is required if any wetted hydraulic surface discloses seawater contamination.
  - All repairs are processed by the cognizant Material Review Board.
  - All seals which have been removed from the installed position or exposed to seawater contamination are replaced

- All hydraulic surfaces that have been exposed to seawater contamination are recleaned per Moog Documents 800-000-100, supplement 32 and MR-Q-6428.

- Reassembly per the same procedures and controls as new hardware.

NOTE: The filter is removed and cleaned during the refurbishment process only if the above level of disassembly discloses seawater.

o Critical Processes/Inspections:

- Weld, filter per Wintec WSF-008-113.

KSC RELATED INSPECTIONS

o Helium cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board circuits per 10REQ-0021, para. 2.3.2.5. (All Failure Causes)

o Hydraulic fluid cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board Hydraulic circuits per 10REQ-0021, para. 2.3.2.6. (All Failure Causes)

o The moisture content and cleanliness (water content and particulate count) of the effluent hydraulic fluid from the rock actuator, the tilt reservoir, the rock reservoir and the tilt actuator are verified per 10REQ-0021, para. 2.3.12.3. (All Failure Causes)

o Proper function of TVC system is demonstrated during Hotfire operations per 10REQ-0021, para. 2.3.16. (All Failure Causes)

o Hydraulic fluid cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board Hydraulic circuits during prelaunch operations per OMRSD File V, Vol. 1 Requirement Number B42HP0.010. (All Failure Causes)

o SRB TVC actuator positioning test is performed per OMRSD File II, Vol. 1 Requirement Number S00000.650. (All Failure Causes)

o Both SRB individual channel null test and actuator individual channel ramp test are performed per OMRSD File II, Vol. 1 Requirement Numbers S00000.670 and .680 respectively. (All Failure Causes)

o Both SRB actuator frequency response and step response tests are performed per OMRSD File II, Vol. 1 Requirement Numbers S00000.720 and .750 respectively. (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.