

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Seals and Sampling Valves, Part of Servoactuator

PART NO: Power Valve and Differential Pressure Transducer Housings - 093-78639-4, 093-78639-5, 093-78639-7, (Plug, Pin, Short); A07110-4, A07110-5 (Plug, Pin, Short, Modified); Actuator Body - 093-78638-5, 093-78638-7, 093-78638-9, (Plug, Pin, Long); A20422-1, A20422-3 (Retainer, Threaded, Pin Plug); Transient Load Relief Valve - 093-49832-4 (Plug, Pin, Short); Related Housings - A23973-3 (Body), (A71183-1 Body), A05362-2 (Housing Assembly, Power Valve), A23007 (Bushing and Spool Assembly)

FM CODE: A06

ITEM CODE: 20-02-13

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Seconds

NUMBER REQUIRED: 2 sets (one per actuator)

DATE: March 1, 2002

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CRITICAL PHASES: Final Countdown, Boost

SUPERCEDES: March 1, 2001

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FMEA PAGE NUMBER: A-236

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SHEET 1 OF 4

APPROVED: S. Parvathaneni

FAILURE MODE AND CAUSES: External Leakage of Hydraulic Fluid at any one of ninety-five Lee plug installations caused by:

- o Defective sealing surface
- o Improper installation
- o Improper clearance

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 Seals and Sampling Valves are designed and qualified in accordance with end item specification 10SPC-0055 and 10SPC-0174 respectively. (All failure causes)
- o Material selection is in compliance with MSFC-SPEC-522A. (All Failure Causes)

- o Lee plugs are two-part assemblies consisting of a cylindrical plug with a tapered hole part way through its center and a tapered pin. Plugs installed in aluminum housings (Power Valve, Body, and Servo. Diff. Press Transducer) are 2024-T6 aluminum per QQ-A-225/6 and anodized per MIL-A-8625 Type II. (All Failure Causes)
- o Plugs installed in the transient load relief valve bushing are 416 CRES per QQ-S-763 with a Rockwell "C" hardness of 20 to 34, and clear passivated per MIL-S-5002. (All Failure Causes)
- o Engineering drawing tolerances for reamed holes in related housings are nominal size +0.0005"/-0.0000" for a class III proof pressure rating per manufacturers recommendation. (Improper Clearance)
- o Secondary retention is provided for all plugs except plugs that seal return pressure (Approx. 65 psig), by one of the following methods: (All Failure Causes)
 - Installing a second plug, modified with .040" through hole, for secondary retention and also provide flow limit (similar to barrier seal) per 10SPC-0055 requirements.
 - Plug is trapped between mating surfaces or components.
 - Plug is backed up by an external, threaded retainer.
- o Installation of Lee plugs is performed by certified personnel per Moog EP3233, which also requires verification of dimensions of plug and bore prior to installation. (All Failure Causes)
- o Servoactuator piece parts, subassemblies and assemblies are cleaned and assembled in a controlled environment conforming to Class 100,000 clean room conditions. The Moog clean room is certified in accordance with Moog PQAR 803-001-100. (Improper Installation)
- o Hydraulic test fluids conform to MIL-H-83282 or MIL-PRF-83282 which was developed to minimize fire hazards. (All Failure Causes)
- o The servoactuator, including seals and sampling valves, is designed per 10SPC-0055 to withstand without failure at a burst pressure of 8,125 psig which is 2.5 times the maximum operating pressure and proof tested to 4,875 psig which is 1.5 times the maximum operating pressure and was subjected to pressure impulse loading applied to primary and secondary inlet ports over a pressure range of 200 to 4,000 psig for a minimum of 100,000 cycles (Ref. 10SPC-0055). (All Failure Causes)
- o Lee plugs, as part of the servoactuator, were subjected to qualification burst pressure test 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, 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)

B. TESTING

VENDOR RELATED TESTING

- o As part of the servoactuator Lee plugs are acceptance tested in accordance with the acceptance procedure defined in Moog report MR A-2406. This procedure includes: (All Failure Causes)
 - Examination of product
 - Proof pressure
 - Return port back pressure
 - Static Leakage
 - Examination of product
- o Refurbished servoactuators are tested as follows:
 - Proof load test per Moog EI-1037 (All Failure Causes)
 - End Item Acceptance Test per Moog MR A-2406 (All Failure Causes)
- o 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. (All Failure Causes)

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KSC RELATED TESTING

- o Hydraulic circuit fluid leak test is performed per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (Defective Sealing Surface, Improper Clearance)
- o Prelaunch hydraulic system leak test is performed per OMRSD File V, Vol. 1 Requirement Number B42HP0.020. (Defective Sealing Surface, Improper Clearance)

The above referenced OMRSD testing is performed every flight.

C. INSPECTION

VENDOR RELATED INSPECTIONS

- o USA SRBE PQAR witnesses all final acceptance test according to approved test procedures per SIP 1127. (All Failure Causes)
- o USA SRBE PQAR verifies inspections of external leakage of hydraulic fluid from components in the body cavity per SIP 1127. This inspection is performed before cover is installed. (All Failure Causes)
- o USA SRBE PQAR verifies material cleanliness and assembly certifications per SIP 1127. (All Failure Causes)

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- o 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
 - Disassembly as required to inspect the body/cylinder interface and bushing, spool and sleeve assemblies of the: selector valve, lock valve and servovalves and power valve for evidence of seawater contamination.
- o 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.
- o Critical Processes/Inspections:
 - Assembling Lee hydraulic plugs per EP 3223

KSC RELATED INSPECTIONS

- o Hydraulic circuit fluid leak test is verified per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (Improper Clearance, Defective Sealing Surface)
- o TVC System is inspected for external leaks per 10REQ-0021, para. 2.3.11.3, 2.3.15.5, and 2.3.16.4 respectively, following low speed GN2 spin, high speed GN2 spin and post hotfire inspection. (Improper Clearance, Defective Sealing Surface)
- o Prelaunch hydraulic system leak test is witnessed per OMRSD File V, Vol. 1 Requirement Number B42HP0.020. (Improper Clearance, Defective Sealing Surface)

D. FAILURE HISTORY

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

E. OPERATIONAL USE

- O Not applicable to this failure mode.