

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Structure and Housings,
Part of Servoactuator

PART NO.: A23973-3 (Body Assembly), FM CODE: A03
A23916-1 (Piston Assembly),
A23914-2 (Cylinder and
Bearing Assembly), A23010
(Transient Load Relief Valve
Assembly), A07401 (Bushing,
Spool and Sleeve Assembly),
A23919 (Power Valve Assembly)
AO7569 Bushing, Selector and lock valve
AO7584 Spool, Selector and lock valve
AO7423 Sleeve, Selector and lock valve

ITEM CODE: 20-02-07 REVISION: Basic

CRITICALITY CATEGORY: 1 REACTION TIME: Seconds

NO. REQUIRED: 2 sets (one per actuator) DATE: March 1, 2002

CRITICAL PHASES: Boost SUPERCEDES: March 1, 1996

FMEA PAGE NO.: A-208 ANALYST: K. Schroeder/S. Finnegan

SHEET 1 OF 4 APPROVED: S. Parvathaneni

CN 044

FAILURE MODE AND CAUSES: Internal leakage due to structural failure between fluid passages caused by:

- o Defective material
- o Fatigue
- o Manufacturing defects

FAILURE EFFECT SUMMARY: Loss of isolation of fluid passages leading 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

- o The Structure and Housings are designed and qualified in accordance with end item specification 10SPC-0055.
- o Material selection is in compliance with MSFC-SPEC-522A. (Defective Material, Fatigue)
- o Actuator body material is 6061-T652 AL alloy, actuator body is machined, detergent cleaned, penetrant inspected, chromic acid anodized, actuator

body yield strength is 34,000 psi and is traceable by serial number. (All Failure Causes)

- o Actuator body was subjected to a burst pressure test with supply pressure of 8125 psig and a return pressure of 60 psig during qualification test. (All Failure Causes)
- o Piston material is 17-4PH CRES grade A forging, heat treated, passivated, shot peened and chrome plated and traceable by serial number. (All Failure Causes)
- o Transient Load Relief Valve material is 17-4PH CRES, heat treated, passivated and magnetic particle inspected and traceable by serial number. (All Failure Causes)
- o Lock Valve material is 440C CRES, heat treated, stress relieved, magnetic particle inspected and traceable by serial number. (All Failure Causes)
- o Fracture Mechanics Analysis was conducted per Fracture Mechanics Report for SRB TVC servoactuator, Battelle Laboratories, 4-30-78. (All Failure Causes)
- o The structure and housing, 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)

B. TESTING

VENDOR RELATED TESTING

- o Servoactuator acceptance test are performed per Moog Report MR A-2406. This procedure includes: (All Failure Causes)
 - Transient Load Relief Valve
 - Quiescent Leakage
 - Interflow Leakage
 - Proof Pressure
 - Examination of Product
- o Refurbished servoactuators are tested as follows: (All Failure Causes)
 - Proof Load Test per Moog EI - 1037
 - 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

- o TVC system internal leakage with one hydraulic system pressurized is verified by test to be less than 6.7 GPM per 10REQ-0021, para. 2.3.12.4. (All Failure Causes)
- o Visual leak check of hydraulic circuit (system) joints is performed per 10REQ-0021, para. 2.3.12.2.
- o TVC system internal leakage of an isolated tilt or rock system with both systems pressurized is verified by test per 10REQ-0021, para. 2.3.12.4. (All Failure Causes)
- o This is the last test to verify acceptable internal leakage.

C. INSPECTION

VENDOR RELATED INSPECTIONS

- o Acceptance tests are witnessed by USA SRBE PQAR per USA SRBE SIP 1127. (All Failure Causes)
- o USA SRBE PQAR verifies material certifications per USA SRBE SIP 1127. (All Failure Causes)
- o USA SRBE verifies traceability per USA SRBE SIP 1127. (All Failure Causes)
- 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
 - Check main piston runout
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 - 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.
- 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.

CN 044

- All nonhermetic electrical/electronic parts which have been exposed to seawater are replaced.
 - 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:
- Heat Treat, Piston, Transient Load Relief Valve, Selector Valve, Lock Valve, Actuator Body, per EP3367.
 - Penetrant Inspection, Opening Piston, Actuator Body, per EP2067.
 - Chrome Plating of TLRV Bushing per QQ-C-320 Class 2
 - Anodizing, Actuator Body, per EP3203.
 - Passivation, Piston, Transient Load Relief Valve, Selector Valve, Lock Valve, per EP3204.
 - Magnetic Particle Inspection, Transient Load Relief Valve, Piston, Selector Valve, Lock Valve, per ASTM E1444.
 - Ultrasonic Inspection, Piston, Actuator Body, per MIL-I-8950, Class A.
 - Solution Heat Treat, Piston, Actuator Body, per AMS 5643.
 - Shot Peening, Piston, per MIL-S-13165.
 - Stress Relief, Actuator Body, per A21587, Note 3. Lock Valve & Selector Valve, EP3211.
 - Stress Relief, Bushing, Selector and Lock Valve, Spool Selector and Lock Valve and Sleeve Selector Lock Valve, per EP 3211.

KSC RELATED INSPECTIONS

- o Internal leakage is verified per 10REQ-0021, para. 2.3.12.4. (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.