

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Structure and Housings,  
Part of Servoactuator

PART NO.: A23973-3 (Actuator Body), FM CODE: A02  
A23916-1 (Piston Assembly),  
A23914-2 (Cylinder and Bearing  
Assembly), A05362-2 (Power  
Valve Housing), A05321-1  
(Servovalve Body), A05744  
(Solenoid Isolation Valve Housing),  
A22206-1 (Differential Pressure  
Transducer Housing Assembly),  
A39349-2 (DPF Body), A71159 (Seal Plate),  
A22089 (Pressure Switch), A71309-1 (End  
Cap and Knob Assembly Switching  
Valve), A71309-2 (End Cap and Knob  
Assembly 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: Final Countdown, Boost

SUPERCEDES: March 1, 1996

FMEA PAGE NO.: A-207

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SHEET 1 OF 5

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CN 044

FAILURE MODE AND CAUSES: External leakage of hydraulic fluid due to fracture of the body or cylinder, piston rod, power valve housing, any of six component housings, or the end cap and knob assembly for either the pressure switching valve or the lock valve caused by:

- o Defective material
- o Fatigue
- o Manufacturing defects

FAILURE EFFECT SUMMARY: Loss of hydraulic fluid from the actuator resulting in fire and explosion will lead to loss of vehicle, mission, and crew during final countdown or boost.

## RATIONALE FOR RETENTION:

## A. DESIGN

- o The Structure and Housings are designed and qualified in accordance with end item specification 10SPC-0055. (All Failure Causes)
- o Material selection is in compliance with MSFC-SPEC-522A. (Defective Material)
- 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 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, traceable by serial number. (Defective Material)
- o Power valve housing material is Aluminum Alloy 6061-T6, T651, T6510 or T6511, raw material is ultrasonic inspected and penetrant inspected after machining, insert housing plugs after anodizing and traceable by serial number. (All Failure Causes)
- o End cap is 17-4PH CRES, heat treated, passivated and traceable by serial number. (All Failure Causes)
- o Solenoid Isolation Valve housing material is 6061-T6, T651, T6510 or T6511 AL alloy grade A forging, raw material is ultrasonic inspected, penetrant inspected, anodized and traceable by serial number. (All Failure Causes)
- o Differential Pressure Transducer housing material is 6061-T6 or T6511 al alloy grade A forging, raw material ultrasonic inspected, penetrant inspected, anodized and plugs installed after anodizing, burst pressure tested at 9,000 psi and traceable by serial number. (All Failure Causes)
- o Dynamic Pressure Feedback housing material is 6061-T6, T651, T6510 or T6511 AL alloy grade A, raw material is ultrasonic inspected, penetrant inspected after machining, anodized and hard anodized with no breaks allowed, filter screens are installed and traceable by serial number. (All Failure Causes)
- o Servovalve housing material is 17-4PH CRES heat treated, stress relieved before finish machining, passivated magnetic particle inspected, and traceable by serial number. (All Failure Causes)
- o Aft skirt is purged with GN2 prior to APU start. This reduces the O<sub>2</sub> concentration to less than 4 percent per OMRSD File II, Vol. I, requirement number S00FM0.430. (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 housings, 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)
  - Proof Pressure
  - Static Leakage
  - Dynamic External Leakage
  - 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.

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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. (All Failure Causes)
- o Verify external leakage at actuator rod ends is less than 1 drop per minute per 10REQ-0021, para. 2.3.12.1. (All Failure Causes)
- o Prelaunch hydraulic system leak test is performed per OMRSD File V, Vol. 1 Requirement Number B42HP0.020. (All Failure Causes)
- o External Leakage at actuator rod ends is verified by test to be less than 0.001 cubic inches per second per OMRSD File V, Vol. 1, Requirement number B42AT0.030. (All Failure Causes)

- o These are last tests that verify no actuator external leakage.
- o The above referenced OMRSD testing is performed every flight.

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 inspection for 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) CN 044
- o USA SRBE performs final visual inspection of deliverable unit per USA SRBE-BPC SIP 1127. (All Failure Causes)
- o USA SRBE PQAR verifies material certifications per USA SRBE SIP 1127. (All Failure Causes)
- o USA SRBE PQAR verifies traceability records 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
  - CN 044
  - 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.
  - 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, End Cap per EP3233, Servovalve per EP3210, Piston per EP3367, Lock Valve per EP3233 and Switching Valve Sleeve and Bushing per EP3202.
  - Penetrant Inspection, Power Valve Housing, Solenoid Isolation Valve Housing, Pressure XDCR Body, DPF Body, Piston, Actuator Body, per EP2067, Servovalve-End Cap Per EP2067.
  - Passivation, End Cap, Servovalve, Piston, End Cap Pin and Lock Valve, per EP3204.
  - Anodizing, Body, Power Valve, Pressure XDCR, Solenoid Isolation Valve, DPF Assembly and Solenoid Valve, per EP3203.
  - Shot Peening, Cylinder Piston, per MIL-S-013165.
  - Chrome Plating, Cylinder Piston, per QQ-C-320, Class 2, type 1.
  - Hydrogen Embrittlement Baking, Piston, per QQ-C-320.
  - Magnetic Particle Inspection, Cylinder, Servovalve-End Cap, Switching Valve, Lock Valve, per ASTM E1444.
  - Ultrasonic Inspection, Actuator Body, Power Valve, Solenoid Isolation Valve, Pressure XDCR, DPF Assembly, per MIL-I-8950, Class A.
  - Stress Relief, Servovalve, per EP3211.

#### KSC RELATED INSPECTIONS

- o Verify external leakage at actuator rod ends is less than 1 drop per minute per 10REQ-0021, para. 2.3.12.1. (All Failure Causes)
- o External leakage at the actuator rod end is verified per OMRSD File V, Vol. 1 Requirement Number B42AT0.030.
- 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. (All Failure Causes)
- o Hydraulic circuit fluid leak test is per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (All Failure Causes)
- o Prelaunch hydraulic system leak test is verified per OMRSD File V, Vol. 1 Requirement Number B42HP0.020. (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.