SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Hydraulic Bootstrap Reservoir

PART NO.: 10203-0008
includes:
Fluid Quantity Transducer:
1711016-350
Bleeder Valve, Hydraulic:
10200-0098-801
Fittings, Connector:
10209-0035-801
10209-0039-801
Fittings, Plug, Bleeder:
MS24391J12L
MS24391S12L (Alt.)
MS24391J4L
MS24391S4L (Alt.)
Vent Plug:
Primary MS24391J8L
Alternate MS24391K8L
O-rings:
Type M83248/1

FM CODE: A05

ITEM CODE: 20-01-28B

REVISION: Basic

CRITICALITY CATEGORY: 1R

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 1, 2002

CRITICAL PHASES: Final Countdown, Boost

SUPERCEDES: March 1, 2001

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ANALYST: B. Snook/S. Parvathaneni

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APPROVED: S. Parvathaneni

FAILURE MODE AND CAUSES: External leakage of hydraulic fluid (System A and/or B) at any one of two internal seals and any one of five external seals caused by:

- Defective or damaged seal
- Defective or damaged sealing surface
- Contamination

-and -

- Defective or damaged seal
- Defective or damaged sealing surface
- Improper torque
- Improperly lockwired
- Contamination

FAILURE EFFECT SUMMARY: Loss of TVC will lead to loss of mission, vehicle and crew.

REDUNDANCY SCREENS AND MEASUREMENTS:

1) Pass - All units are subject to ATP during turnaround and refurbishment.

2) Pass - Hydraulic fluid reservoir level measurements B58Q1350C, B58Q1351C.

3) Fail - Contamination

RATIONALE FOR RETENTION:

A. DESIGN

- The Hydraulic Bootstrap Reservoir is designed and qualified in accordance with end item specification 10SPC-0052. (All failure causes)
- O-ring material is viton which is compatible with hydraulic fluid. (Contamination)
- Hydraulic fluid is MIL-H-83282 or MIL-PRF-83282, which was developed to minimize the fire hazard. (Contamination)
- The reservoir cylinder material is anodized 6061-T6 aluminum. (Defective or Damaged Sealing Surface)
- The H.P. side is designed to withstand 1.5 times operating pressure (4875 psig) without failure or permanent deformation and 2.5 times operating pressure (8125 psig) without burst. (Defective or Damaged Seal and Defective or Damaged Sealing Surface)
- Fluid procurement is controlled per SE-S-0073. (Contamination)
- All thread fittings and connectors are torqued per engineering specifications and are lockwired per MS 33540 as applicable. (Improper Torque, Improperly Lockwired)
- The L.P. side is designed to withstand three times operating pressure (165 psig) without failure or permanent deformation and 4.0 times operating pressure (220 psig) without burst. (Defective or Damaged Seal and Defective or Damaged Sealing Surface)
- The top and bottom assemblies are sealed with an O-ring and a bolted flange with a 302 stainless steel retainer. (Defective or Damaged Sealing Surface)
- Piston is sealed with "T" seals which are compatible with hydraulic fluid. (Contamination)

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- o Fluid ports are internal straight thread bosses per MS33649 with MIL-S-8879 threads. (Defective or Damaged Sealing Surface)

- o The aft skirt area is purged with GN2 prior to APU startup. This reduces the 02 concentration to less than four percent per OMRSD File II, Vol. 1, requirement number S00FM0.430. (All Failure Causes)

- o Qualification testing verified design requirements as reported in Arkwin Qualification Test Report QTR-1711016-1, Rev. A. (All Failure Causes)

B. TESTING

- o Acceptance testing is performed per Arkwin ATP 1711016-1 on each flight item at vendor's plant. This includes a visual examination, proof pressure test to 4875 psig on the H.P. side and 165 psig on the L.P. side, fill and bleed operation check, operating pressure of 3125 $\pm$ 125 psig, external leakage check with zero leakage and internal leakage check at 15 cc per hour and cleanliness. (All Failure Causes)

- o 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.

- o During refurbishment and prior to reuse the hydraulic reservoir is processed for rework per 10SPC-0131 and acceptance tested per the criteria of 10SPC-0052 at USA SRBE/KSC Florida operations. This includes visual examination, cleanliness verification, proof pressure test to 4975 $\pm$ 100 psig on the H.P. side and 170 $\pm$5 psig on the L.P. side, fill and bleed operation check, operating pressure of 3125 $\pm$ 125 psig, external leakage should be insufficient to form a drop, and internal leakage not to be more than 15 ML per hour (All Failure Causes)

- o 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. (Contamination)

- o 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)

- o Hydraulic fluid level is monitored during test operations: (All Failure Causes)

  Low speed GN2 spin per 10REQ-0021, para. 2.3.11.1
  High speed GN2 spin per 10REQ-0021, 2.3.15.1
  Hotfire per 10REQ-0021, 2.3.16.1

- o Prelaunch hydraulic system leak test is performed per OMRSD File V, Vol. 1, requirement number B42HP0.020. (All Failure Causes)

- o Helium leak test to less than 1 x 10^{-4} sccs is performed per 10REQ-0021, para. 2.3.3.3. (All Failure Causes)

C. INSPECTION

I. VENDOR RELATED INSPECTIONS

- Verification of material certifications by USA SRBE PQAR per SIP 1140 (Defective or Damaged Seal)
- Penetrant inspection (cylinder-1711016-200) is performed during manufacturing per ARKWIN SPEC PS-105 Class A. (Defective or Damaged Sealing Surface)
- Verification of welding and weld filler conformance to specifications is performed by USA SRBE PQAR per SIP 1140. (Defective or Damaged Sealing Surfaces)
- Verification of Vendor QA dimensional and O-ring sealing surfaces inspections is performed by USA SRBE PQAR per SIP 1140. (Defective or Damaged Seal)
- Verification of Vendor buyoff of O-ring installations is performed by USA SRBE PQAR per SIP 1140. (Defective or Damaged Seal)
- Verification of cleanliness is performed by USA SRBE PQAR per SIP 1140. (Contamination)
- Witnessing of proof test is performed by USA SRBE PQAR per SIP 1140. (All Failure Causes)
- Witnessing of final ATP is performed by USA SRBE PQAR per SIP 1140. (All Failure Causes)
- Refurbished units are subject to the same ATP standards as new units and requirements are verified per SIP 1140 by USA SRBE PQAR. (All Failure Causes)
- Critical Processes/Inspections:
  - Anodizing per MIL-A-8625
  - Penetrant inspection per PS-105

II. KSC RELATED REFURBISHMENT INSPECTIONS

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

III. KSC RELATED ASSEMBLY AND OPERATIONS INSPECTIONS

- O-rings and sealing surfaces are inspected prior to assembly per 10REQ-0021, para. 2.3.0. (Defective or Damaged Seal and Defective or DamagedSealing Surface)

- Visual inspection for proper torque per 10REQ-0021, para. 2.1.4. (Improper Torque)

- 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. (Contamination)

- Visual inspection for proper lockwire per 10REQ-0021, para. 2.1.4. (Improperly Lockwired)

- Verification of hydraulic system leak test with helium to an acceptable level per 10REQ-0021, para. 2.3.3.3. (Defective or Damaged O-ring and Defective or Damaged Sealing Face)

- 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 B42HPO.010. (Contamination)

- 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. (Contamination)

- GN2 cleanliness and composition (purity and particulate count) are verified prior to hydraulic system fill and bleed per 10REQ-0021, para. 2.3.2.2. (Contamination)

- Visual inspection for Hydraulic circuit fluid leaks are verified per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (All Failure Causes)

- Proper function of TVC system is demonstrated during hotfire operations per 10REQ-0021, paras. 2.3.11, 2.3.15 and 2.3.16 respectively for: (All Failure Causes)

  - Low speed GN2 spin
  - High speed GN2 spin
  - Hotfire

- TVC System is inspected for external leaks per 10REQ-0021, paras. 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)

- Prelaunch hydraulic system leak test is performed per OMRSD File V, Vol. 1 requirement number B42HP0.020. (All Failure Causes)

D. FAILURE HISTORY

- Failure Histories may be obtained from the PRACA database.

E. OPERATIONAL USE

- Not applicable to this failure mode.