

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Hydraulic Bootstrap Reservoir

PART NO.: 10203-0008 FM CODE: A02
includes:
1711016-350 (Fluid Quantity Transducer)
10200-0098-801 (Bleed Valve)
10209-0035-801 (Fitting Connector)
10209-0039-801 (Fitting Connector)

ITEM CODE: 20-01-28B REVISION: Basic

CRITICALITY CATEGORY: 1 REACTION TIME: Seconds

NO. REQUIRED: 2 DATE: March 1, 2001

CRITICAL PHASES: Final Countdown, BoostSUPERCEDES: March 31, 2000

FMEA PAGE NO.: A-94 ANALYST: B. Snook/S. Parvathaneni

SHEET 1 OF 6 APPROVED: S. Parvathaneni

FAILURE MODE AND CAUSES: External leakage of hydraulic fluid (Systems A and/or B) at any one of six fitting O-rings or any one of two cover seals or bleeder valve body seal O-ring caused by:

- o Defective or damaged O-ring
- o Defective or damaged sealing surface
- o Improperly lockwired
- o Improper torque
- o Thread failure
- o Contamination

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 Hydraulic Bootstrap Reservoir is designed and qualified in accordance with end item specification 10SPC-0052. (All failure causes)
- o O-ring material is Viton which is compatible with hydraulic fluid. (Defective or Damaged O-Ring)

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- o All threaded fittings and connectors are torqued per engineering specifications and are lockwired per MS 33540 as applicable. (Improper Torque, Improperly Lockwired)
- o Hydraulic fluid is MIL-H-83282 or MIL-PRF-83282, which was developed to minimize the fire hazard. (Contamination)
- o The high pressure (HP) 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. (Thread Failure)
- o The L.P. side is designed to withstand 3.0 times operating pressure (165 psig) without failure or permanent deformation and 4.0 times operating pressure (220 psig) without burst. (Thread Failure)
- o The reservoir fluid end cap is attached to the reservoir body with a bolted flange and 302 stainless steel retainer and is sealed by two non-redundant O-rings. (Defective or Damaged Sealing Surface)
- o Fluid procurement is controlled per SE-S-0073. (Contamination)
- o Fluid ports are internal straight thread bosses per MS33649 with MIL-S-8879 threads. (Thread Failure)
- o The aft skirt area is purged with GN2 prior to APU start up. This reduces the O2 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)

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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 ± 125 psig, external leakage check with zero leakage and internal leakage check at 15cc per hour and cleanliness. (All Failure Causes)
- 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/TBE Florida operations. This includes visual examination, cleanliness verification, proof pressure test to 4975 ± 100 psig on the H.P. side and 170 ± 5 psig on the L.P. side, fill and bleed operation check operating pressure of 3125 ± 125 psig, external leakage insufficient to form a drop and internal leakage check not to exceed 15 ML/hour (All Failure Causes)
- o Helium is sampled for cleanliness and composition (purity and particulate count) prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.5. (Contamination)
- o Helium leak test to less than 1×10^{-4} sccs is performed per 10REQ-0021, para. 2.3.3.3. (All Failure Causes)

- o Visual leak check of hydraulic circuit (system) joints is performed prior to hotfire per 10REQ-0021, para. 2.3.12.2. (All Failure Causes)
- o Hydraulic fluid level is monitored during test operations per 10REQ-0021: (All Failure Causes)
 - Low speed GN2 spin, para. 2.3.11
 - High speed GN2 spin, para. 2.3.15
 - Hotfire, para. 2.3.16
- o Prelaunch hydraulic system leak test is performed per OMRSD File V, Vol. 1, Requirement Number B42HP0.020. (All Failure Causes)
- o Hydraulic fluid is sampled for cleanliness and composition (purity and particulate count) prior to introduction on-board the flight hardware per 10REQ-0021, para. 2.3.2.6. (Contamination)
- o Sample hydraulic fluid for cleanliness and moisture content (particulate count and water content) from actuators and the reservoirs per 10REQ-0021, para. 2.3.12.3. (Contamination)
- o Hydraulic fluid is sampled 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 (effluent) is sampled for moisture per OMRSD File V, Vol. 1, Requirement Number B42HP0.011. (Contamination)

The above referenced OMRSD testing is performed every flight.

C. INSPECTION

I. VENDOR RELATED INSPECTIONS

- o Verification of reservoir material certifications by USA SRBE PQAR per SIP 1140. (Thread Failure)
- o Verification of Vendor QA dimensional and O-ring sealing surfaces inspections by USA SRBE PQAR per SIP 1140. (Defective or Damaged O-ring)
- o Verification of vendor buyoff of all O-ring installations by USA SRBE PQAR per SIP 1140. (Defective or Damaged Sealing Surface)
- o Verification of cleanliness by USA SRBE PQAR per SIP 1140. (Contamination)
- o Witnessing of proof test by USA SRBE PQAR per SIP 1140. (All Failure Causes)
- o Cover characteristics are verified by USA SRBE PQAR per SIP 1140. (Defective or Damaged O-ring)

- o Verification of O-ring age control by USA SRBE PQAR per SIP 1140. (Defective or Damaged O-ring)
- o Witnessing of final ATP by USA SRBE PQAR per SIP 1140. (All Failure Causes)
- o 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)
- o Verification of bleed valve material certifications by USA SRBE PQAR per SIP 1390 (Defective or Damaged Sealing Surface).
- o Verify threads per SIP 1140. (Thread failure)
- o Critical Processes/Inspections:
 - None

II. KSC RELATED REFURBISHMENT INSPECTIONS

- o Visual inspection of Hydraulic Reservoir will be performed per 10SPC-0131, para. II. (All Failure Causes)
- o Functional testing of Hydraulic 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 O-rings are inspected with 3X magnification prior to installation for absence of physical defects (cuts, voids, creases, flashing or burrs) per 10REQ-0021, para. 2.3.0. (Defective or Damaged Sealing Surface)
- o Hydraulic sealing surfaces are inspected prior to installation verifying no contaminant or obstruction exists per 10REQ-0021, para. 2.3.0 (Defective or Damaged Sealing Surface)
- o Witness the torque applied to critical components per 10REQ-0021, para. 2.1.4. (Improper Torque)
- o Verify installation of lockwire per 10REQ-0021, para. 2.1.4. (Improperly Lockwired)
- o Helium (influent) cleanliness and composition (purity and particulate count) are verified per 10REQ-0021, para. 2.3.2.5 (Contamination)

- o Performance of visual leak check of hydraulic circuit (system) joints per 10REQ-0021, para. 2.3.12.2. (All Failure Causes)
- o Verification of hydraulic system helium leak test to $\leq 1X 10^{-6}$ SCCS per 10REQ-0021, para. 2.3.3.3. (All Failure Causes)
- o Hydraulic fluid (influent) cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.6. (Contamination)
- o The cleanliness and moisture (water content) of the effluent hydraulic fluid from the actuators and the tilt reservoirs are verified per 10REQ-0021, para. 2.3.12.3. (Contamination)
- 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. (Contamination)
- o Verification of hydraulic fluid (effluent) for moisture per OMRSD File V, Vol. 1, Requirement Number B42HP0.011. (Contamination)
- o Verification of GN2 (influent) cleanliness and composition (purity and particulate count) prior to hydraulic system fill and bleed per 10REQ-0021, para. 2.3.2.2. (Contamination)
- o Hydraulic circuit fluid leak test is performed per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (All Failure Modes)
- o Proper function of TVC system is demonstrated during hotfire operations per 10REQ-0021 to include: (All Failure causes)
 - Low speed GN2 spin, para. 2.3.11
 - High speed GN2 spin, para. 2.3.15
 - Hotfire, para. 2.3.16
- o TVC System is inspected for external leaks per 10REQ-0021 following low speed GN2 spin, para. 2.3.11.3, high speed GN2 spin, para. 2.3.15.5 and Hotfire, para. 2.3.16.4. (All Failure Causes)
- o Helium cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.5. (Contamination)
- o Prelaunch hydraulic system leak test is performed 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.