

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Hydraulic Bootstrap Reservoir

PART NO.: 10203-0008 FM CODE: A08  
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, Boost SUPERCEDES: March 31, 2000

FMEA PAGE NO.: A-100 ANALYST: B. Snook/S. Parvathaneni

SHEET 1 OF 5 APPROVED: S. Parvathaneni

FAILURE MODE AND CAUSES: Rupture caused by:

- o High pressure fluid leak to air side (one seal)
- o Material defect
- o Manufacturing defect
- o Contamination
- o Piston jamming

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. (Contamination)
- o Hydraulic fluid is MIL-H-83282 or MIL-PRF-83282, which was developed to minimize the fire hazard. (Contamination)
- o The reservoir material is anodized 6061-T6 aluminum. (Material Defect)

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- o Fluid procurement is controlled per SE-S-0073. (Contamination)
- o Cylinder support assembly maintains piston alignment. (Piston Jamming)
- o Material selection is per MSFC-SPEC-522A. (Material Defect)
- o The 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. (Material Defect)
- o The LP side is designed to withstand three times operating pressure (165 psig) without failure or permanent deformation and four times operating pressure (220 psig) without burst. (Material Defect)
- o During qualification testing, the LP side was tested to 220 psig without failure. The HP side was tested to 8125 psig without burst and finally burst at 9700 psig. (All Failure Causes)
- o The top and bottom assemblies are mated with a bolted flange with a 302 stainless steel retainer and fourteen bolts. (Material Defect)
- o Piston is sealed with "T" seals, sealing air side and high pressure side. (High Pressure Fluid Leak To Air Side)
- o Fluid ports are internal straight thread bosses per MS33649 with MIL-S-8879 threads. (Manufacturing Defect)
- o The aft skirt area is purged with GN2 prior to APU start up per OMRSD File II, Vol. 1, requirement number S00FM0.430. This reduces the O2 concentration to less than four percent. (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, piston breakaway pressure, external leakage check with zero leakage and internal leakage check at 15 cc 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  $4975 \pm 100$  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 insufficient to form a drop and internal leakage not to exceed 15 ML per hour and cleanliness. (All Failure Causes)
- o Helium leak test to less than  $1 \times 10^{-4}$  sccs is performed per 10REQ-0021, para. 2.3.3.3. (All Failure Causes)

- o Bleeder valve is proof pressure tested to 6500 psig (S.F. 2.0) per Circle Seal ATP TM-1068 (All Failure Causes)
- o Helium is sampled for cleanliness and composition (purity and particulate count) prior to introduction on-board the flight hardware per 10REQ-0021, para. 2.3.2.5. (Contamination)
- o Visual leak check of hydraulic circuit (system) joints 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. 2.3.11.1
  - High speed GN2 spin, para. 2.3.15.1
  - Hotfire, para. 2.3.16.1
- o Inspect TVC system for damage - no leaks, signs of rubbing, or discoloration are allowed per 10REQ-0021 following low speed GN2 spin, para. 2.3.11.3, and high speed GN2 spin, para. 2.3.15.5. (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 Hydraulic fluid is sampled for cleanliness and composition (purity and particulate count) prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.6. (Contamination)
- o Sample hydraulic fluid moisture content and cleanliness (water content and particulate count) from the 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 B42HPO.010. (Contamination)
- o Hydraulic fluid (effluent) is sampled for moisture per OMRSD File V, Vol. 1, Requirement Number B42HP0.011. (Contamination)

## C. INSPECTION

### I. VENDOR RELATED INSPECTIONS

- o Source Inspection Plan verifies proper manufacturing and assembly by USA SRBE PQAR per SIP 1140. (Manufacturing Defects)
- o Verification of material certifications by USA SRBE PQAR per SIP 1140. (Material Defect)
- o Verification of bleed valve material certification by USA SRBE PQAR per SIP 1390. (Material Defect)

- o Verification welding and weld filler conformance to specifications by USA SRBE PQAR per SIP 1140. (Manufacturing Defect)
- o Penetrant inspection is performed during manufacturing per 10SPC-0052. (Manufacturing Defects)
- o Verification of Vendor QA dimensional and O-ring sealing surfaces inspections by USA SRBE PQAR per SIP 1140. (High Pressure Fluid Leak To Air Side)
- o Verification of Vendor buyoff of all O-ring installations by USA SRBE PQAR per SIP 1140. (Manufacturing Defect)
- o Verification of cleanliness by USA SRBE PQAR per SIP 1140. (Contamination)
- o Witnessing of proof test by USA SRBE PQAR per SIP 1140. (Material Defect)
- o Verify O-ring age control by USA SRBE PQAR per SIP 1140. (Material Defect)
- 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 USA SRBE PQAR. (All Failure Causes)
- o Critical Processes/Inspections:
  - Welding per MIL-W-6858
  - Anodize per MIL-A-8625
  - Penetrant per PS-105
  - Heat Treat per AMS-5673 CH900

## 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 Helium cleanliness and composition (purity and particulate count) are verified prior to introduction on-board the flight hardware per 10REQ-0021, para. 2.3.2.5. (Contamination)
- o Hydraulic system helium leak test to an acceptable level per 10REQ-0021, para. 2.3.3.3. (Material Defect and Manufacturing Defect)

- o Hydraulic fluid 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 Verify hydraulic fluid cleanliness and moisture content (water content and particulate count) from the actuators and the reservoirs 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 GN2 (influent) is verified for cleanliness and composition (purity and particulate count) prior to hydraulic system fill and bleed per 10REQ-0021, para. 2.3.2.2. (Contamination)
- o Verification of visual leak check of hydraulic circuit (system) joints per 10REQ-0021, para. 2.3.12.2. (All Failure Causes)
- 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 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.