

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Hydraulic Pump

PART NO.: 10201-0051-801, -802(Alt.)

FM CODE: A09

Fittings, Connector

10209-0038-801

10209-0077-801

10209-0036-801

O-Rings

Type M83248/1

Plug, Drain

MS24391 J4L

Plug, Seepage

10604-0001-101 (only for information - GSE part)

ITEM CODE: 20-01-29

REVISION: Basic

CRITICALITY CATEGORY: 1R

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 1, 2002

CRITICAL PHASES: Final Countdown, Boost

SUPERCEDES: March 1, 2001

FMEA PAGE NO.: A-111

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SHEET 1 OF 6

APPROVED: S. Parvathaneni

CN 044

FAILURE MODE AND CAUSES: External leakage of hydraulic fluid (System A and/or B) at shaft seal and pump mounting flange seal or MS fitting caused by:

- o Improper handling/installation
- o Contamination
- o Defective or damaged seal
- o Defective or damaged sealing surface
- and-
- o Defective or damaged O-ring
- o Defective or damaged sealing surface
- o Improper torque
- o Improperly lockwired
- o Thread failure surface
- o Contamination

FAILURE EFFECT SUMMARY: Fire and explosion will lead to loss of mission, vehicle and crew.

REDUNDANCY SCREENS AND MEASUREMENTS:

- 1) Pass - All units are subject to ABEX ATP TP-675.
- 2) Fail - Loss of redundant seal undetectable.

3) Fail - Contamination.

RATIONALE FOR RETENTION:

A. DESIGN

- o The Hydraulic Pump is designed and qualified in accordance with end item specification 10SPC-0053. (All Failure Causes) (BI-1805R1)
- o Hydraulic fluid is MIL-H-83282 or MIL-PRF-83282 which was developed to minimize fire hazard. (Contamination)
- o O-ring material is Viton which is compatible with hydraulic fluid. (Contamination)
- o Threaded inserts are installed per MS 33537. (Thread Failure)
- o Threaded bosses are per MS 33649. (Thread Failure)
- o Face seal is 52100 alloy steel heat treated to Rockwell hardness of C58-62 (310-350 KSI). (Defective or Damaged Sealing Surface)
- o Shaft seal nose is bronze, CA673. (Defective or Damaged Seal Surface)
- o O-ring seal is static. (Defective or Damaged Seal)
- o O-ring static seal glands are per MIL-G-5514. (Defective or Damaged Sealing Surface)
- o All threaded fittings and connectors are torqued per engineering specifications and are lockwired per MS 33540. (Improper Torque, Improperly Lockwired)(BI-1805 R1)
- o Pump handling and pump/APU mating is controlled by USA SRBE per SIP 1258. (Improper Handling/Installation)
- o Aft skirt area is purged with GN2 prior to APU startup. This reduces the O2 concentration to less than four percent per OMRSD File II, Vol. 1, requirement number S00FM0.430. (All Failure Causes)
- o Fluid procurement is controlled per SE-S-0073. (Contamination)
- o Qualification testing verified design requirements as reported in ABEX Qualification Test Report AER-729. (All Failure Causes)

B. TESTING

- o Acceptance test is performed per ABEX ATP TP-675 on each flight item. This includes visual examination, break in run, overspeed test to 4755 rpm, functional test which includes filter patch test, depressurized start, and pressurization. (All Failure Causes)

- o Proof pressure testing consists of 300 psi on inlet port and case drain port and 4875 psi to the discharge port. (Defective or Damaged O-Ring, Defective or Damaged Sealing Surface, Thread Failure and Improper Torque)
- o During refurbishment, the pump is reworked per 10SPC-0131 and tested per ATP TP-675 to ensure proper operations. (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 Effluent hydraulic fluid is verified for moisture content and cleanliness (water content and particulate count) from the rock actuator, the tilt reservoir, the rock reservoir and the tilt actuator per 10REQ-0021, para. 2.3.12.3. (Contamination)
- o Proper operation of the pump is verified by test during: (All Failure Causes)
 - Low speed GN2 spin per 10REQ-0021, para. 2.3.11
 - High speed GN2 spin per 10REQ-0021, para. 2.3.15
 - Hotfire per 10REQ-0021, 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 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 Prelaunch hydraulic system leak test is performed per OMRSD File V, Vol. 1, requirement number B42HP0.020. (All failure causes)
- o Hydraulic system leak test with helium to an acceptable level per 10REQ-0021, para. 2.3.3.3. (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. (Contamination)

C. INSPECTION

VENDOR RELATED INSPECTIONS

- o Verification of lockwire is performed by USA SRBE PQAR per SIP 1258. (Improperly Lockwired)
- o Verification of torque operations is performed by USA SRBE PQAR per SIP 1258. (Improper Torque)

- o Nondestructive Evaluation (NDE) is performed on subassemblies by USA SRBE PQAR per SIP 1258. (Defective or Damaged Sealing Surface)
- o Verification of vendor buy off of o-ring installation is performed per SIP 1258 by USA SRBE PQAR. (Defective or Damaged O-ring)
- o Witnessing of acceptance testing is performed per SIP 1258. (All Failure Causes)
- o Verification of vendor buy off of external sealing surfaces is performed by USA SRBE PQAR per SIP 1258. (Defective or Damaged Sealing Surface).
- o Verification that Parker Abex has performed and accepted all required Hydraulic Pump refurbishment and inspections per TP-1210 by USA SRBE PQAR per SIP 1258. (All Failure Causes) CN 044
- o Critical Processes/Inspections:
 - Heat Treat per MIL-H-6875
 - Penetrant inspection per ASTM E1417
 - Magnetic particle inspection per ASTM E1444

KSC RELATED INSPECTIONS

- o O-rings and sealing surfaces are inspected prior to assembly per 10REQ-0021, para. 2.3.0. (Defective or Damaged O-ring and Defective or Damaged Sealing Surface)
- o Assembly and torque are witnessed per 10REQ-0021, para. 2.1.4. (Improper Handling/ Installation, Improper Torque)
- o Pump/APU mounting flange bolt torque and lockwire are witnessed per 10REQ-0021, para. 2.1.4. (Improper Handling/Installation)
- o Lockwire is verified per 10REQ-0021, para. 2.1.4. (Improperly Lockwired)
- o Hydraulic system leak test with helium is verified per 10REQ-0021, para. 2.3.3.3. (All Failure Causes)
- o Verification of torque and lockwiring of Drain Plug per OMRSD File V, Vol.I, requirement number B42GEN.010 and B42GEN.020 (Improper torque, Improper lockwiring) (BI-1805R1)
- o 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)

- o The moisture content and cleanliness (water content and particulate count) of the effluent hydraulic fluid from the rock actuator, the tilt reservoir, the rock reservoir and the tilt actuator are verified per 10REQ-0021, para. 2.3.12.3. (Contamination)
- o Verify Rock Hydraulic Reservoir level is greater than 30 percent during low speed GN2 spin per 10REQ-0021, para. 2.3.11.2. (All Failure Causes)
- o Verify Tilt Hydraulic Reservoir level is greater than 30 percent during low speed GN2 spin per 10REQ-0021, para. 2.3.11.2. (All Failure Causes)
- o Verify Rock Hydraulic Reservoir level is greater than 50 percent during high speed GN2 spin per 10REQ-0021, para. 2.3.15.2. (All Failure Causes)
- o Verify Tilt Hydraulic Reservoir level is greater than 50 percent during high speed GN2 spin per 10REQ-0021, para. 2.3.15.2. (All Failure Causes)
- o Visual inspection for hydraulic circuit fluid leaks is performed per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (All Failure Causes)
- o Proper function of TVC system is demonstrated during hotfire operations per 10REQ-0021, para. 2.3.11, 2.3.15 and 2.3.16 respectively for: (All Failure Causes)
 - Low speed GN2 spin
 - High speed GN2 spin
 - Hotfire, (Includes verification of rock and tilt reservoirs to between 50 and 90 percent)
- o TVC system is inspected for external leaks following low speed GN2 spin per 10REQ-0021, para. 2.3.11.3, external leaks following high speed GN2 spin per 10REQ-0021, para. 2.3.15.5 and post hotfire inspection per 10REQ-0021, para. 2.3.16.4. (All Failure Causes)
- 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 Hydraulic pump seepage plug is inspected for evidence of hydraulic pump shaft seal leakage after GN2 spins and hotfire per 10REQ-0021, para. 2.3.11.3, 2.3.15.5 and 2.3.16.4. (Defective or Damaged Sealing Surface)
- o Hydraulic pump seepage plug is inspected for evidence of hydraulic pump shaft seal leakage during closeout per OMRSD File V, Vol. 1, Requirement Number B42HP0.040. (Defective or Damaged Sealing Surface)
- o Visual inspection of pump shaft seal seepage plug prior to closeout per OMRSD File V, Vol. 1, Requirement Number B42HP0.040. (Defective or Damaged Sealing Surface)
- o Prelaunch hydraulic system leak test is performed per OMRSD File V, Vol. 1, Requirement Number B42HP0.020. (All Failure Causes)

- o Helium purity 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)

D. FAILURE HISTORY

- o Failure Histories may be obtained from the PRACA database.

E. OPERATIONAL USE

- o Not applicable to this failure mode.

F. WAIVERS

- o BI-1805 R1 dated 12-21-89, Level III approval: SB3-01-2979

Requirement: 10CEI-0001, Rev. H, para 3.3.6.18 states that threaded parts shall be positively locked.

Departure from the Requirement: One shaft seal drain plug on the Hydraulic Pump is not positively locked.

Rationale for Approval of the Waiver: The shaft seal drain plug is not configured for lockwire. The plug was qualified in an unlockwired condition including flight vibration, thermal shock and flight environment temperature requirements. No flight history exists from thirty two (32) flights of plugs untorquing during flight or spashdown. Pressure in this area is at ambient under normal operating conditions.