SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Hydraulic Accumulator and GN2 Charging Assembly

PART NO.: (1) 10207-0002-803 FM CODE: A01
includes:
MS24391S4L (Plug Bleeder)
MS24391J4L (Plug Bleeder) (Alt.)
MS24391J5L (Vent, Plug Bleeder)
MS24391K5L (Alt)

(2) 10207-0020-104 (GN2 Pr. Block - Rock)
10207-0021-104 (GN2 Pr. Block - Tilt)
includes:
10201-0057-801 (Fill Valve)
10400-0126-801 (Pressure Transducer)
10209-0034-801 (Fitting)
MS24391J4L (Plug Bleeder, Fitting)
Type M83248/1 (O-ring)

(3) 10200-0072-101 (GN2 Rigid Line - Rock)
10200-0072-103 (GN2 Rigid Line - Rock) (Alt.)
10200-0072-102 (GN2 Rigid Line - Tilt)
10200-0072-104 (GN2 Rigid Line - Tilt) (Alt.)
10209-0067-801 (GN2 Fitting Elbow)
10209-0132-801 (GN2 Fitting Elbow) (Alt.)
10209-0034-801 (GN2 Fitting Connector)
10209-0035-801 (Hydraulic Fitting Connector)

ITEM CODE: 20-01-49 REVISION: Basic

CRITICALITY CATEGORY: 1 REACTION TIME: Seconds

NO. REQUIRED: 2 DATE: March 1, 2001 DCN 042

CRITICAL PHASES: Final Countdown, Boost SUPERCEDES: March 31, 2000 DCN 042

FMEA PAGE NO.: A-159 ANALYST: B. Snook / S. Parvathaneni

SHEET 1 OF 6 APPROVED: S. Parvathaneni

FAILURE MODE AND CAUSES: External leakage of hydraulic fluid (System A and/or B) at one fitting o-ring, or accumulator shell to end cap o-ring caused by:

- Contamination
- Defective or damaged O-ring
- Defective or damaged sealing surface
- Defective shell or end cap material
- Thread failure
- Improper torque
- Improperly lockwired

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

- The Hydraulic Accumulator and GN2 Charging Assembly is designed and qualified in accordance with end item specification 10SPC-0051. (All Failure Causes)
- The accumulator is designed for a proof pressure of two times operating pressure (6500 psig) and a burst pressure of four times operating pressure (13,000 psig). (Defective Shell or End Cap Material, Thread Failures)
- Fittings are lockwired per MS33540 with Monel lockwire. (Improperly Lockwired)
- The accumulator shell bore is glass bead peened with .002-.004 inch diameter glass beads to a 12-16 microinch finish. (Defective or Damaged Sealing Surface)
- Hydraulic fluid is MIL-H-83282 or MIL-PRF-83282 which was developed to minimize the fire hazard. (Contamination)

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- Fluid procurement is controlled by SE-S-0073. (Contamination)
- The accumulator is located downstream of the filter assembly, which is a 5 micron filter. (Contamination)
- O-ring is nitrile material which is compatible with hydraulic fluid. (Contamination)
- Aft skirt area is purged with GN2 prior to APU start. This reduces the 02 concentration to less than four percent per OMRSD File II, Vol. 1, requirement number S00FM0.430. (All Failure Causes)
- Qualification testing verified design requirements as reported in Parker-Hannifin Qualification Test Report QTR 5790001, Rev. NC. (All Failure Causes)

B. TESTING

- Acceptance testing is performed per Parker-Hannifin ATP PTS 5790001 at vendor's plant. This includes visual examination, proof pressure test to 6500 psig, performance and leakage tests, bonding and cleanliness. (All Failure Causes)
- During refurbishment and prior to reuse the accumulator is processed for rework per 10SPC-0131 and ATP testing per 10SPC-0051 by USA SRBE/TBE Florida operations. This includes visual examination, proof pressure test to 6600 $\pm$ 100 psig, leakage tests, bonding and cleanliness. (All Failure Causes)

- Acceptance testing of the high pressure GN2 charging valve is per Parker PTS 5800002 at vendor's plant. This includes visual examination, proof pressure test to 6500 psig and no external leakage at 3250 psig, cleanliness and post test examination and installation verification. (Defective or Damaged Sealing Surface, Thread Failure, Contamination)

- During refurbishment and prior to reuse the high pressure GN2 charging valve is processed for rework per 10SPC-0131 and acceptance tested per the criteria of 10SPC-0051 by USA SRBE/TBE Florida operations. This includes visual examination, proof pressure test to 6600 $\pm$ 100 psig and no external leakage at 3300 $\pm$ 50 psig, cleanliness and post test examination and installation verification. (All Failure Causes)

- 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)

- Visual leak check of hydraulic circuit (system) joints is performed per 10REQ-0021, para. 2.3.12.2. (All Failure Causes)

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

- 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)

- 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)

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

- Hydraulic circuit fluid leak test is performed per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (All Failure Causes)

- Functional test is performed 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

C. INSPECTION

I. VENDOR RELATED INSPECTIONS

- Vendor inspection of seals by USA SRBE PQAR per SIP 1125. (Defective or Damaged O-ring)

- o Verification of static and dynamic leakage tests by USA SRBE PQAR per SIP 1125. (All Failure Causes)
- o Witnessing of accumulator acceptance test by USA SRBE PQAR per SIP 1125. (All Failure Causes)
- o Witnessing of charging valve acceptance test by USA SRBE PQAR per SIP 1125. (Defective or Damaged Sealing Surface, Thread Failure)
- o Verify threads per SIP 1125. (Thread Failures)
- o Verification of seal interfaces and lockwire by USA SRBE PQAR per SIP 1125. (Defective or Damaged Sealing Surface, Improperly Lockwired)
- o Critical Processes/Inspections:
  - Shot peening accumulator shell per MIL-STD-852.

II. KSC RELATED REFURBISHMENT INSPECTION

- o Visual inspection of accumulator will be performed per 10SPC-0131, para. II. (All Failure Causes)
- o Functional testing of accumulator 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 Assembly and torque are witnessed per 10REQ-0021, para. 2.1.4. (Improperly Torque)
- o Lockwire is verified per 10REQ-0021, para. 2.1.4. (Improperly Lockwired)
- o Hydraulic system helium leak test is verified per 10REQ-0021, para. 2.3.3.3. (All Failure Causes)
- 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)

- 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)

- 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)

- 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)

- Proper function of TVC system is verified during hotfire per 10REQ-0021, para. 2.3.16 (includes verification of rock and tilt reservoirs between 50 and 90 percent). (All Failure Causes)

- Prelaunch hydraulic system leak check is witnessed per OMRSD File V, Vol. 1 Requirement Number B42HP0.020. (All Failure Causes)

- O-Rings, K-Seals and E-Seals (as applicable) are inspected prior to installation for absence of physical defects per 10REQ-0021, para. 2.3.0. (Defective or Damaged O-ring)

- 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)

- Performance of visual leak check of hydraulic circuit (system) joints per 10REQ-0021, para. 2.3.12.2. (All Failure Causes)

- 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)

- 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)

- Hydraulic circuit fluid leak test is witnessed per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (All Failure Causes)
- 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)

- 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)

D. FAILURE HISTORY

- Failure Histories may be obtained from the PRACA database.

E. OPERATIONAL USE

- Not applicable to this failure mode.