SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Hydraulic Accumulator (Alternate)

PART NO.: 10207-0029-801
(interchangeable with 10207-0002-803)
10209-0035-801 (Fitting, Connector)
Type M83248/1 (O-ring)

FM CODE: A04

ITEM CODE: 20-01-49A

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-173

ANALYST: B. Snook/S. Parvathaneni

SHEET 1 OF 4

APPROVED: S. Parvathaneni

FAILURE MODE AND CAUSES: Rupture (System A and/or B) caused by:

- Material defect
- Manufacturing defect

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 is designed and qualified in accordance with end item specification 10SPC-0150. (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). Actual burst during Qual test occurred at 16,750 psig. (All Failure Causes)

- The accumulator shell is heat treated Inconel 718. (Material Defect)

- Hydraulic fluid is MIL-H-83282 or MIL-PRF-83282 which was developed to minimize the fire hazard. (Material Defect) DCN 042

- Threaded port is per MS33649. (Manufacturing Defect Such as Thin Walls)

- Material selection is per MSFC-SPEC-522A. (Material Defect)

- Three witness coupons are tested per heat treat lot to ensure proper material properties. (Material Defect)

- The 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 Metal Bellows Qualification Test Report CR 1258, Rev. Basic. (All Failure Causes)

B. TESTING

- Acceptance testing is performed per Metal Bellows ATP 83376. This includes visual examination, proof pressure test to 6500 psig, performance and leakage tests, pressure gage accuracy to +250 psig and cleanliness. (All Failure Causes)

- During refurbishment and prior to reuse the accumulator is reworked per10SPC-1031 and acceptance tested by USA SRBE/TBE Florida operations per the criteria of 10SPC-0150. This includes visual examination, proof pressure test to 6540 $\pm$ 40 psig with leakage insufficient to form a liquid drop or no permanent deformation and cleanliness verification. (All Failure Causes)

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

- 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

- 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)

- The above referenced OMRSD testing is performed every flight.

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

C. INSPECTION

I. VENDOR RELATED INSPECTIONS

- Manufacturing is controlled by Source Inspection Plan SIP 1327. (Manufacturing Defects)
- Verification of material certifications and heat treat data by USA SRBE PQAR per SIP 1327. (Material Defect)
- Verification of housing inspections by USA SRBE PQAR per SIP 1327. (Material Defects, Manufacturing Defects)
- Verification of weld filler control procedures by USA SRBE PQAR per SIP 1327. (Manufacturing Defects)
- Verification of penetrant inspection by USA SRBE per SIP 1327. (Manufacturing Defects)
- Verification of mass spectrometer leak checks of seal welds and charge tube by USA SRBE PQAR per SIP 1327. (Material Defect, Manufacturing Defects)
- Witnessing of acceptance test by USA SRBE PQAR per SIP 1327. (All Failure Causes)
- Refurbishment units are subject to the same inspections and test verifications by USA SRBE PQAR as new units per SIP 1327. (All Failure Causes)
- Critical Processes/Inspections:
  - Heat treat per MIL-H-6875.
  - Weld per MIL-W-8641 and MIL STD-2219 (per Metal Bellows ES1206).

II. KSC RELATED REFURBISHMENT INSPECTION

- Visual inspection of accumulator will be performed per 10SPC-0131, para. II. (All Failure Causes)
- 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

- Assembly and torque are witnessed per 10REQ-0021, para. 2.1.4. (Manufacturing Defects)
- Hydraulic system helium leak test is verified per 10REQ-0021, para. 2.3.3.3. (Material Defect, Manufacturing Defects)
- Hydraulic circuit fluid leak test is verified per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (All Failure Causes)

- 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)

- 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)

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

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

- Hydraulic fluid is verified for cleanliness and composition (purity and particulate count) prior to introduction to on board flight hardware per 10REQ-0021, para. 2.3.2.6 and during prelaunch per OMRSD File V, Vol. I, requirement number B42HPO.010. (Material Defects)

- Verification of hydraulic fluid (effluent) sampled for moisture and disolved air content per OMRSD File V, Vol. I, requirement number B42HPO.011 and .070 respectively. (Material Defects)

- 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 GN2spin, high speed GN2 spin, and post Hotfire inspection. (All Failure Causes)

D. FAILURE HISTORY

- Criticality category 1:

  - Failure histories may be obtained from the PRACA database.

E. OPERATIONAL USE

- Not applicable to this failure mode.