SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Check Valve and Filter Assembly (CVFA)

PART NO: 10201-0047-802
10201-0047-803 (Alt.)
Includes

Fittings, Connector
10209-0038-801
10209-0106-801
10209-0157-801 (Alt.)
10209-0105-801
10209-0067-801 or
10209-0132-801 (Alt.)
O-rings
Type M83248/1

FM CODE: A06

ITEM CODE: 20-01-30

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Seconds

NUMBER REQUIRED: 2

DATE: March 1, 2001 CN 042

CRITICAL PHASES: Boost

SUPERCEDES: March 31, 2000 CN 042

FMEA PAGE NUMBER: A-119

ANALYST: B. Snook/S. Parvathaneni

SHEET 1 OF 4

APPROVED: S. Parvathaneni

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

- Material defect
- Manufacturing defect
- Defective or damaged element sealing surface
- Contamination

FAILURE EFFECT SUMMARY: Loss of TVC will lead to loss of mission, vehicle and crew.

REDUNDANCY SCREENS AND MEASUREMENTS: N/A

RATIONALE FOR RETENTION:

A. DESIGN

- The Check Valve and Filter Assembly is designed and qualified in accordance with end item specification 10SPC-0048. (All Failure Causes) (BI-1604R1)

- o Filter is designed for use with MIL-H-83282 or MIL-PRF-83282 hydraulic fluid with a rated flow of 55 GPM and maximum flow of 70 GPM. (Manufacturing Defect)

CN 042

- o Design collapse pressure is 4875 psid minimum. (Material Defect)
- o Filter is 5 micron absolute with a containment capability of 13 grams of AC fine dust at 55 GPM at 80 psid. (Contamination)
- o Filter is not reused. (All Failure Causes)
- o Fluid procurement is controlled by SE-S-0073. (Contamination)
- o End seals are 2024-T851 aluminum cemented to the filter element. (Defective or Damaged Sealing Surface)
- o Filter mesh consists of 304L CRES and HC3-20 nylon and 800 PES polyester. (Material Defect)
- o Qualification testing verified design requirements as reported in Purolator Technologies Qualification Test Report No. 11362. (All Failure Causes)

B. TESTING

- o Acceptance testing of the filter element is performed per PTI PAT 7583008. This includes bubble point testing and cleanliness testing. (All Failure Causes)
- o Acceptance testing of the CVFA is performed per PTI PAT 7588778 on each new flight unit. This includes a visual examination, proof pressure test to 4875 psig, external leakage, operational leak check and cleanliness. (All Failure Causes) (BI-1604-R1)
- o During refurbishment and prior to reuse CVFA is reworked per 10SPC-0131 and acceptance tested by USA SRBE/TBE Florida operations per the criteria of 10SPC-0048. This includes visual examination, proof pressure test to 4975$\pm$100 psig, external leakage and operational leak check for five minutes at 3300 $\pm$ 50 psig to verify leakage is less than that required to form a drop, and cleanliness verification. (All Failure Causes)(BI-1604-R1)
- o Helium is verified for cleanliness and composition (purity and particu late count) prior to introduction on-board the flight hardware per 10REQ-0021, para. 2.3.5.2. (Contamination)
- o Hydraulic fluid is verified for cleanliness and composition are verified for (purity and particulate count) prior to introduction to on-board the flight hardware per 10REQ-0021, para. 2.3.2.6. (Contamination)
- o Verify (effluent) hydraulic fluid cleanliness and moisture (water content and particulate count) from the actuators and the reservoirs per 10REQ-0021, para. 2.3.12.3. (Contamination)
- o CVFA is exposed to operating pressure during hotfire test operations per 10REQ-0021 which includes: (All Failure Causes)

  - Low speed spin, para. 2.3.11
  - High speed spin, para. 2.3.15
  - Hotfire, para. 2.3.16

- Hydraulic fluid is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board flight hardware during prelaunch operations per OMRSD File V, Vol. 1, Requirement Number B42HP0.010. (Contamination)

C. INSPECTION

I. VENDOR RELATED INSPECTIONS

- Verification of material certifications by USA SRBE PQAR per SIP 1264. (Material Defects)
- Verification of vendor buy off of sealing surfaces by USA SRBE PQAR per SIP 1264. (Defective or Damaged Sealing Surface)
- Witnessing of acceptance test by USA SRBE PQAR per SIP 1264. (All Failure Causes)
- Verification of contamination check by USA SRBE PQAR per SIP 1264. (Con-tamination)
- CRITICAL PROCESSES/INSPECTIONS
  - None

II. KSC RELATED REFURSISHMENT INSPECTIONS

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

- 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)
- 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)
- Verify hydraulic fluid cleanliness and moisture content (particulate count and water content) from the actuators, the reservoirs effluent per 10REQ-0021, para. 2.3.12.3. (Contamination)
- Proper function of TVC System is demonstrated during hotfire operations per 10REQ-0021 to include: (All Failure Causes)

- High speed GN2 spin, para. 2.3.15
- Hotfire, para. 2.3.16

o Hydraulic fluid cleanliness and composition (purity and particulate count) are verified prior to introduction on-board the flight hardware during prelaunch operations per OMRSD File V, Vol. 1, Requirement Number B42HP0.010. (Contamination)

D. FAILURE HISTORY

Criticality 1

o No SRB failure history per this failure mode.

E. OPERATIONAL USE

o No applicable to this failure mode.

F. WAIVERS

o BI-1604-R1, 07-26-88, Level III approval SB3-01-1634

o Requirement: CVFA to meet ultimate factors of safety, that is, Proof pressure -1.5 x limit pressure and ultimate pressure 2.0 x limit pressure per 10CEI-0001 requirement number 3.2.1.7.1.1.K.

o Departure from Requirement: Analysis indicated that the check valve retaining ring groove and poppet plate show a negative margin of safety at proof (4875 psig) and burst (8125 psig) pressures.

o Rationale for Approval of Waiver: Two CVFAs were tested at PTI technologies in April 1988, one at 4875 psig (1.5 x normal operating pressure) and the other one at 8125 psig (2.5 x normal operating pressure). The units did not fail or leak and were functional. Inspection of both units indicated yielding as predicted; however the yielding was not uncontrolled and did not affect the check valve operation (per Purolator Test Report # 11524).

On previous flights, check valve failures due to excessive reverse pressurization was not found. The valves are proof pressure tested to 4875 psig during refurbishment to verify structural integrity of the used unit. (For refurbishment at USA SRBE/TBE Florida Operation, now the unit is tested to 4925 $\pm$ 50 psig).

Based on PTI testing along with the refurbishment tests and inspection, provides the confidence to clear new units and first or second reuse units for flights.