

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Fluid Manifold Assembly

PART NO.: 10201-0066-102
10201-0098-801 (alt.)

FM CODE: A04

ITEM CODE: 20-01-47

REVISION: Basic

CRITICALITY CATEGORY: 1R

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 1, 2001

CRITICAL PHASES: Boost

SUPERCEDES: March 31, 2000

FMEA PAGE NO.: A-147

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SHEET 1 OF 5

APPROVED: S. Parvathaneni

DCN 042
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FAILURE MODE AND CAUSES: High pressure relief valve (normally closed) fails to remain closed (System A and B) caused by:

- o Spring failure
- o Contamination
- o Bent Pilot Poppet
- o Galled poppet(s)
- o Galled seat
- o Improper spring preload
- o Improper assembly
- o Defective or Damaged O-Ring
- o Bent stem

FAILURE EFFECT SUMMARY: Loss of TVC will lead to loss of mission, vehicle and crew. One success path remains after the first failure. Operation is not affected until both paths are lost.

REDUNDANCY SCREENS AND MEASUREMENTS:

- o Pass - All units are subject to ATP during turnaround and refurbishment.
- o Fail - Loss of redundancy not detectable.
- o Fail - Contamination.

RATIONALE FOR RETENTION:

A. DESIGN

- o The high pressure relief valve (HPRV) is a pilot type spring loaded closed with provision for adjustment of cracking pressure valve design, cleaning, testing, and handling are per 10SPC-0054. (Improper Assembly and Improper Spring Preload)
- o The valve is a cartridge design. (Improper Assembly)
- o HPRV has a grade 16 finish on critical surfaces (Galled Seat)
- o The pilot poppet is 440 CRES heat treated to a hardness of C58-62 (tensile strength of about 350,000 psi). (Galled Poppet[s])
- o The main poppet is 440 CRES heat treated to a hardness of C54-56. (Galled Poppet[s])
- o The main seat is 440 CRES heat treated to a hardness of C58-62. (Galled Seat)
- o The pilot seat is 440 CRES heat treated to a hardness of C54-56. (Galled Seat)
- o The pilot poppet, main poppet and the pilot seat are a matched set with close tolerances. (Galled Poppet[s], Galled Seat and Bent Pilot Poppet)

Note: This design rationale is applicable to the original manifold only and is not applicable to the alternate manifold.

- o Hydraulic fluid is MIL-H-83282 or MIL-PRF-83282 which was developed to reduce the potential of fire. (Contamination)
- o Fluid procurement is controlled per SE-S-0073. (Contamination)
- o The aft skirt area is purged with GN2 prior to APU start up. This reduces the O2 concentration to less than four percent per OMRSD File II, Vol. 1, requirement number S00FM0.430. (All Failure Causes)
- o Qualification testing verified design requirements as reported in Pneudraulic, Inc. Qualification Test Report QTR 8090, Rev. A or Wright Components QTR 80335A for the alternate manifold. (All Failure Causes)

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B. TESTING

- o Acceptance testing of the HP relief valve is performed per Pneudraulics ATP 1674-1 or Wright Components ATP-11355 for the alternate manifold. This includes visual examination, cleanliness, proof pressure to 4875 psig, internal leakage check, cracking pressure and reseal pressure, and cleanliness. (All Failure Causes)
- o Acceptance testing of the manifold assembly is performed per Wright Components ATP-15980 at vendor's plant. This includes visual examination, cleanliness, proof pressure testing to 4875 psig on HP side and 1300 psig on LP side, internal leakage check, crack and reseal pressures, external leakage to less than that which is required to form aliquid drop, and cleanliness. (All Failure Causes)

- o During refurbishment and prior to reuse the fluid manifold assembly is processed for rework per 10SPC-0131 and acceptance tested per the criteria of 10SPC-0054 at USA SRBE/TBE Florida operations. This includes visual examination; cleanliness verification, proof pressure testing to 4975 ± 100 psig on the H.P. side, and maintaining pressure on L.P side between 1350 psig max. to 140 psig minimum internal leakage check, crack and reseal pressures and external leakage should be insufficient to form a liquid drop. (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)
- 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 The hydraulic manifold HPRVs are functionally checked per 10REQ-0021, para. 2.3.10.3. (All Failure Causes)
- o Functional test is performed during hotfire operations per 10REQ-0021 para. 2.3.15 and 2.3.16 respectively: (All Failure Causes)
 - High speed GN2 spin
 - Hotfire
- 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)

The above referenced OMRSD testing is performed every flight.

C. INSPECTION

I. VENDOR RELATED INSPECTIONS

- o Verification of cleaning, pre and post ATP is performed per 10PRC-0620 by USA SRBE per SIP 1252 or SIP 1298. (Contamination)
- o Verification of valve assembly to configuration documentation is performed by USA SRBE PQAR per SIP 1252 or SIP 1298. (Improper Assembly, Improper Spring Preload)
- o Verification of material certifications of high and low pressure relief valves is performed by USA SRBE PQAR per SIP 1259 or SIP 1298. (Galled Poppet[s] and Galled Seat)
- o Verification of visual and dimensional inspection of high and low pressure relief valves is performed by USA SRBE PQAR per SIP 1259 or SIP 1298. (Improper Assembly)

- o Witnessing of relief valve contamination level is performed by USA SRBE PQAR per SIP 1259 or SIP 1298. (Contamination)
- o Witnessing of internal leakage test of relief valves is performed by USA SRBE PQAR per SIP 1259 or SIP 1298. (All Failure Causes)
- o Witnessing of crack and reseal pressure for relief valves is performed by USA SRBE PQAR per SIP 1259 or SIP 1298. (All Failure Causes)
- o Verification of final cleaning of the relief valves to 10PRC-0620 is performed by USA SRBE PQAR per SIP 1259 or SIP 1298. (Contamination)
- o Witnessing of acceptance test of the assembled manifold is performed by USA SRBE PQAR per SIP 1252 or SIP 1298. (All Failure Causes)
- o Verification of refurbished units acceptance data pack is performed by USA SRBE PQAR per SIP 1252 or SIP 1298. (All Failure Causes)
- o Critical Processes/Inspections:
 - Heat treat per MIL-H-6875

II. KSC RELATED REFURBISHMENT INSPECTION

- o Visual inspection of fluid manifold assembly will be performed per 10SPC-0131, para. II. (All Failure Causes)
- o Functional testing of fluid manifold assembly 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 to on-board circuits per 10REQ-0021, para. 2.3.2.5. (Contamination)
- o Hydraulic fluid 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 The moisture content and cleanliness (water content and particulate count) of the effluent hydraulic fluid from the rock actuator, the tilt actuator, the tilt reservoir and the rock reservoir per 10REQ-0021, para. 2.3.12.3 are verified. (Contamination)
- o Hydraulic manifold HPRV function is functionally verified per 10REQ-0021, para. 2.3.10.3. (All Failure Modes)

- o Proper function of TVC system is demonstrated during hotfire operations per 10REQ-0021, para. 2.3.15 and 2.3.16 respectively. (All Failure Causes)
 - High speed GN2 spin
 - Hotfire
- 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)

D. FAILURE HISTORY

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

E. OPERATIONAL USE

- o Not applicable to this failure mode.