

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ORBITAL MANEUVER FMEA NO 03-3 -1007 -2 REV: 4/12/88

ASSEMBLY : PRESSURIZATION SUBSYSTEM CRIT. FUNC: 1R
 P/N RI : MC284-0481 CRIT. HDW: 2
 P/N VENDOR: VEHICLE 102 103 104
 QUANTITY : 4 EFFECTIVITY: X X X
 : TWO PER POD PHASE(S): PL LO X OO X DO X LS

PREPARED BY: DES D W CARLSON APPROVED BY: DES *[Signature]* REDUNDANCY SCREEN: A-FAIL B-FAIL C-PASS
 REL C M AKERS REL *[Signature]* APPROVED BY (NASA): SSM *[Signature]*
 QE W J SMITH QE *[Signature]* REL *[Signature]* 8-26-88

ITEM:
 VALVE, CHECK, HELIUM/PROPELLANT, QUAD POPPETS.

FUNCTION:
 EACH CHECK VALVE QUAD WITH 4 POPPETS IN SERIES-PARALLEL ARRANGEMENT PROVIDES PARALLEL REDUNDANCY FOR HELIUM PRESSURIZATION AND SERIES REDUNDANCY TO LIMIT BACK FLOW OF PROPELLANT LIQUID AND/OR VAPORS FROM THE PROPELLANT TANKS INTO THE PRESSURIZATION SYSTEM. A 304L 25 MICRON FILTER IS UTILIZED AT THE INLET. THE VALVE UTILIZES A CUTTER SEAL DESIGN CONCEPT (TWO SEALING SURFACES PER POPPET).

FAILURE MODE:
 FAILS CLOSED, FAILS TO OPEN, RESTRICTED FLOW THROUGH POPPET.

CAUSE(S):
 POPPET BINDS IN GUIDE, CORROSION, CONTAMINATION, VIBRATION, ACCELERATION.

EFFECT(S) ON:
 (A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE
 (A, B) LOSS OF REDUNDANCY (ONE OF 2 FLOW PATHS).
 (C, D) NO EFFECT UNLESS PARALLEL POPPETS OF VALVES FAIL CLOSED.

(E) FUNCTIONAL CRITICALITY EFFECT - POTENTIAL LOSS OF CREW/VEHICLE. LOSS OF PRESSURIZATION CAPABILITY COULD RESULT IN MIXTURE RATIO PROBLEMS AND INABILITY TO UTILIZE PROPELLANT REQUIRED FOR DEORBIT, AND INABILITY TO CONTROL VEHICLE DURING ENTRY AND LANDING (WT. & C.G). PROPELLANT TANK OR OTHER STRUCTURAL FAILURE MAY OCCUR DURING LANDING DUE TO EXCESSIVE PROPELLANT REMAINING. NO INSTRUMENTATION IS AVAILABLE FOR DETECTION OF FAILURE OF PARALLEL CHECK VALVE ELEMENT.

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REV: 4/22/88

DISPOSITION & RATIONALE:

(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE

(A) DESIGN

THE FACTOR OF SAFETY FOR PROOF PRESSURE IS 1.5 AND 2.0 FOR BURST PRESSURE. PROPELLANT COMPATIBLE MATERIALS ARE UTILIZED. MANUAL ISOLATION VALVES PROVIDE ADDITIONAL VAPOR MIGRATION PROTECTION DURING INACTIVE GROUND PERIODS. SERIES-PARALLEL REDUNDANT POPPETS PROVIDE REDUNDANCY FOR THE CLOSED FAILURE MODE. A SINGLE FLOW PATH THROUGH THE CHECK VALVE IS ADEQUATE FOR ALL NORMAL FLOW CONDITIONS. ABORT FLOWS (304SCFM FOR INDIVIDUAL PODS) INCREASE THE PRESSURE DROP THROUGH A SINGLE CHECK VALVE FLOW PATH TO NO GREATER THAN 10 PSI. THIS WOULD NOT RESULT IN ANY DECREASE IN ENGINE INLET PRESSURE OR CHANGE IN PROPELLANT MIXTURE RATIO. THE CAUTION AND WARNING SYSTEM WOULD NOT ACTIVATE UNDER THIS CONDITION. WSTF TESTS SHOW THAT THE OME CAN FUNCTION OVER A MUCH WIDER RANGE OF PRESSURE VARIATION. TO LIMIT THE POTENTIAL FOR POPPET SHAFT BINDING OR GENERATION OF CONTAMINATION, THE 3-POINT POPPET GUIDE PINS UTILIZE SAPPHIRE AS A WEAR RESISTANT SURFACE. A 25 MICRON INLET FILTER WILL ALSO REDUCE THE POTENTIAL FOR A CLOSED FAILURE BY LIMITING THE POTENTIAL FOR CONTAMINATION TO CAUSE BINDING OF MOVING PARTS.

(B) TEST

QUALIFICATION TEST

(4 UNITS) - RANDOM VIBRATION, SHOCK, SURGE PRESSURE (3800 CYCLES), LIFE CYCLES (100,000 CYCLES), THERMAL (-180 TO +150 DEG F), BURST (740 PSI), PROPELLANT COMPATIBILITY. ALSO QUALIFIED AS PART OF POD ASSEMBLY - VIBRO-ACOUSTIC TESTING AT JSC - 131 EQUIVALENT MISSIONS. HOT-FIRE TEST PROGRAM AT WSTF, 517 TESTS (24 EQUIVALENT MISSION DUTY CYCLES). APPROX 7 YEARS PROPELLANT EXPOSURE.

ACCEPTANCE TEST

PROOF PRESSURE, EXTERNAL LEAKAGE, PRESSURE DROP, CRACKING PRESSURE, RESEAT PRESSURE, INTERNAL LEAKAGE, CLEANLINESS, FILTER BUBBLE POINT.

GROUND TURNAROUND

V43CBO.080 PERFORMS LEAK AND FUNCTIONAL FIRST AND EVERY FIFTH FLIGHT.
V43CBO.085 PERFORMS TOTAL PACKAGE LEAK AND FUNCTIONAL EACH FLIGHT.
V43CEO.045 PERFORMS HELIUM OFF LOADING WHICH PURGES THE HELIUM SYSTEM AND CLOSES MANUAL VALVE EVERY FLIGHT.
V43CFO.025 PERFORMS HELIUM SYSTEM ACTIVATION EVERY FLIGHT.

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(C) INSPECTION

RECEIVING INSPECTION

MATERIALS AND PROCESSES CERTIFICATION ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS TO LEVEL 100 FOR MMH AND 100A A FOR NTO AND CORROSION PROTECTION PROVISIONS (CHEMICAL TREATMENT) ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MANUFACTURING ASSEMBLY AND INSTALLATION PROCEDURES ARE VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

WELDS ARE PENETRANT INSPECTED OR MAGNETIC PARTICLE INSPECTED

CRITICAL PROCESSES

THE WELDING PROCESS PER RAO107-027 AND VERIFICATION THAT WELDS MEET SPECIFICATION REQUIREMENTS ARE VERIFIED BY INSPECTION. THE WELDS ARE VISUALLY INSPECTED

TESTING

TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. ACCEPTANCE TEST INCLUDING POPPET OPERATION IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING, PACKAGING, STORAGE AND SHIPPING REQUIREMENTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

THE CHECK VALVE HAS NOT FAILED CLOSED OR EXHIBITED RESTRICTED FLOW. HOWEVER, SEVERAL INSTANCES OF SLIGHTLY HIGH CRACKING PRESSURE (5.7 PSI MAX) HAVE OCCURRED. THESE ARE DOCUMENTED ON AB1378 (WSF) AB3452 (WSF) AND AB7431 (JSC). THE RCS HAS HAD SIMILAR OCCURRENCES DOCUMENTED BY AC0131, AB6893, AND AC0077. NO CORRECTIVE ACTION WAS CONSIDERED NECESSARY. NO ADVERSE EFFECT ON SYSTEM PERFORMANCE WOULD RESULT. IN MOST CASES THE FAILURE DID NOT REPEAT.

CAR AD0858 RECORDS A RECENT FAILURE WHEREIN A SLIGHTLY HIGH CRACKING PRESSURE AND ERRATIC LEAK RATES OCCURRED DUE TO IMPROPER SEATING OF THE POPPET. THIS WAS DUE TO PROPELLANT RESIDUE ACCUMULATION ON THE SAPPHIRE POPPET GUIDES. THIS CONDITION CAN NORMALLY BE CORRECTED BY CYCLING THE VALVE.

(E) OPERATIONAL USE

FOR PARALLEL ELEMENTS IN FUEL SIDE CHECK VALVE FAILED CLOSED, CLOSE HELIUM ISOLATION VALVES AND OPERATE IN BLOWDOWN TO PC LIMIT. FOR PARALLEL ELEMENTS IN OXIDIZER SIDE CHECK VALVE FAILED CLOSED - CONTINUE OPERATION TO PC LIMIT. FOR EITHER FAILURE, PROPELLANT IN UNAFFECTED TANK MAY BE UTILIZED IN MIXED CROSSFEED. ULLAGE BLOWDOWN OPERATION ADEQUATE FOR DEORBIT AFTER OMS -2 WHEN PROPELLANT REMAINING IS LESS THAN 40%. TYPICAL DEORBIT BURN REQUIRES LESS THAN 30% PROPELLANT.

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NONDESTRUCTIVE EVALUATION

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CRITICAL PROCESSES

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TESTING

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