

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : FWD - REACTION CONTROL FMEA NO 03-2F -101095-2 REV: 04/09/88

ASSEMBLY : PRESSURIZATION CRIT. FLNG: 12
P/N RI : MC284-0481-0001/-0002 CRIT. HDW: 3
P/N VENDOR: RSD10500-001/-011 VEHICLE 102 103 104
QUANTITY : 2 EFFECTIVITY: X X X
: ONE PER PROPELLANT PHASE(S): PL LO X 00 DO LS

PREPARED BY: DES L P BURTON APPROVED BY: DES R. L. Smith REDUNDANCY SCREEN: A-PASS B-FAIL C-PASS
REL R P DIEHL REL J. P. Burton APPROVED BY (NASA): SSM R. L. Smith
QE W J SMITH QE W. J. Smith REL W. J. Smith RE W. J. Smith
QE W. J. Smith QE W. J. Smith

ITEM:
VALVE, QUAD, CHECK, HELIUM, (CV101,102)

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 VAPORS FROM THE PROPELLANT TANKS TO THE REGULATOR. A 304L 25 MICRON FILTER IS UTILIZED AT THE INLET. VALVE UTILIZES CUTTER SEAL DESIGN CONCEPT (TWO SEALING SURFACES PER POPPET)

FAILURE MODE:
FAILS CLOSED, RESTRICTED FLOW.

CAUSE(S):
CONTAMINATION, CORROSION, POPPET OR SPRING BINDS IN GUIDE OR CRACKS, IMPACT FRACTURE OF SEAT OF POPPET, VIBRATION, ACCELERATION, SHOCK

EFFECT(S) ON:
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE

- (A) LOSS OF REDUNDANCY - PARALLEL FLOW PATH.
- (B) NO EFFECT
- (C) NO EFFECT
- (D) NO EFFECT

(E) FUNCTIONAL CRITICALITY EFFECT - POSSIBLE CREW VEHICLE LOSS. FAILURE OF PARALLEL POPPETS WOULD POSSIBLY RESULT IN INABILITY TO BURN OR DEplete ALL RCS PROPELLANT IN ADDITION TO MIXTURE RATIO PROBLEMS WITH RESULTANT THRUSTER FIRING PROBLEMS. POSSIBLE LOSS OF CONTROL DURING MATED COAST/EXTERNAL TANK SEPARATION. 1R EFFECT ASSUMES LOSS OF CHECK VALVE AND NOT ENOUGH ULLAGE TO PERFORM ET SEPARATION. VEHICLE INSTRUMENTATION CAN ONLY VERIFY THE FAILURE WHEN BOTH PARALLEL PATHS THROUGH THE CHECK VALVE FAIL CLOSED. A SINGLE FAIL CLOSED PATH CANNOT BE VERIFIED.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : FWD - REACTION CONTROL FMEA NO 03-2F -101095-2 REV: 04/05/88

DISPOSITION & RATIONALE:

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

(A) DESIGN

SERIES-PARALLEL REDUNDANT POPPETS PROVIDE REDUNDANCY FOR THE CLOSED FAILURE MODE. SERIES REDUNDANCY LIMITS THE BACKFLOW OF PROP VAPORS.

ULLAGE PRESSURE IS CONSIDERED A LEVEL OF REDUNDANCY FOR NOMINAL ET SEPARATION.

TO LIMIT THE POTENTIAL FOR POPPET SHAFT BINDING OR GENERATION OF CONTACT, THE GUIDE PINS UTILIZE SAPPHIRE, 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

THE QUALIFICATION TEST PROGRAM UTILIZED FOUR UNITS. INCLUDED IN THE TESTING WAS RANDOM VIBRATION, SHOCK, SURGE PRESSURE (3800 CYCLES), LIFE CYCLES (100,000 CYCLES). THERMAL (-180 TO +150 DEG F), POPPET FLOW STABILITY, BURST (740 PSI) AND PROPELLANT COMPATIBILITY.

THE UNIT WAS ALSO QUALIFIED AS PART OF THE POD ASSY IN THE VIBRO-ACOUSTIC TEST PROGRAM AT JSC (131 EQUIVALENT MISSIONS) AND IN THE HOT FIRE PROGRAM AT WSTF (24 EQUIVALENT MISSION DUTY CYCLES AND APPROX 7 YEARS OF PROPELLANT EXPOSURE).

ACCEPTANCE TESTING INCLUDES PROOF PRESSURE, EXTERNAL LEAKAGE, FLOW TESTS CRACKING/RESEAT PRESS., INTERNAL LEAKAGE, PRESSURE DROP, FILTER BUBBLE POINT, AND CLEANLINESS.

OMRSD PERFORMS THE FOLLOWING: A LEAK AND FUNCTIONAL CHECK OF THE CHECK VALVE (EACH POPPET) THE FIRST FLIGHT, THE FIFTH FLIGHT AND EVERY FIVE FLIGHTS THEREAFTER AND ON CONTINGENCY BASIS. A LEAK AND FUNCTIONAL CHECK ON THE CHECK VALVE (TOTAL UNIT) THE SECOND FLIGHT AND EACH FLIGHT THEREAFTER. MOISTURE VERIFICATION AFTER THE FIRST FLIGHT AND ON A CONTINGENCY BASIS THEREAFTER. SYSTEM HELIUM SAMPLING BEFORE THE THIRD FLIGHT AND EVERY THIRD FLIGHT THEREAFTER. HELIUM SYSTEM ACTIVATION EVERY FLIGHT. A REGULATOR RESPONSE CHECK EVERY FLIGHT AND ON A CONTINGENCY BASIS. A REGULATOR RESPONSE (LOW PRESSURE) TEST ON A CONTINGENCY BASIS. HELIUM OFFLOADING THE SECOND FLIGHT AND EVERY FLIGHT THEREAFTER. A REGULATOR LEAK/FUNCTIONAL TEST EVERY FLIGHT AND ON A CONTINGENCY BASIS.

(C) INSPECTION

RECEIVING INSPECTION

RAW MATERIAL IS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS TO LEVEL 100 FOR MMH AND 100A FOR NTO IS VERIFIED BY INSPECTION. CORROSION PROTECTION IS VERIFIED BY INSPECTION.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : FWD - REACTION CONTROL FMEA NO 03-2F -101095-2 REV:04/09/88

ASSEMBLY/INSTALLATION

CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

WELDS ARE PENETRANT OR MAGNETIC PARTICLE INSPECTED.

CRITICAL PROCESSES

WELDING PER RA0107-027 IS VERIFIED BY INSPECTION AND VISUALLY INSPECTED.

TESTING

ATP IS WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING PROCEDURES ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

THE CHECK VALVE HAS NOT FAILED CLOSED OR EXHIBITED RESTRICTED FLOW. HOWEVER, INSTANCES OF SLIGHTLY HIGH CRACKING PRESSURE HAVE OCCURRED. THESE WERE DOCUMENTED IN CARS ACC131, AB6893, ACC077, THESE OCCURRENCES WERE DUE TO PROPELLANT RESIDUE BUILD-UP ON THE SAPPHIRE POPPET GUIDES AND IS NORMALLY CORRECTED BY CYCLING THE VALVE. TO HELP PREVENT RESIDUE THE OMSD REQUIRES CLOSURE OF THE MANUAL VALVES POST FLIGHT FOLLOWED BY A RESIDUAL HELIUM PURGE OF THE SYSTEM.

OMS ALSO 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 AB7401 (JSC).

(E) OPERATIONAL USE

REQUIRES TWO POPPET FAILURES BEFORE ACTION IS REQUIRED. IF FAILURE OCCURS PRIOR TO ET SEP, BLOWDOWN CAN BE USED TO PERFORM A NOMINAL ET SEP IF NO MAJOR DISPERSIONS OCCUR.