

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :AFT - REACTION CONTROL FMEA NO 03-2A -201095-2 REV:04/28/88

ASSEMBLY :PRESSURIZATION
P/N RI :MC284-0481-0001/-0002
P/N VENDCR:RS010500-001/-011
QUANTITY :4
:2 PER POD
:1 PER HELIUM SUPPLY

VEHICLE
EFFECTIVITY:
PHASE(5): PL LO X OO X DO X IS
CRIT. FUNC: 1R
CRIT. HDW: 2
102 103 104
X X X
X

PREPARED BY:
DES L P BERTON
REL R P DIEHL
QE W J SMITH

REDUNDANCY SCREEN: A-PASS B-FAIL C-FAIL
APPROVED BY: R. E. Burt APPROVED BY (NASA):
DES R. E. Burt SSM
REL R. E. Burt REL
QE R. E. Burt QE

ITEM:

VALVE, QUAD, CHECK, HELIUM CV201, 202, 301, 302.

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 DEPLET ALL RCS PROPELLANT IN ADDITION TO MIXTURE RATIO PROBLEMS WITH RESULTANT THRUSTER FIRING PROBLEMS. POSSIBLE LOSS OF CONTROL DURING MATED COAST/EXTERNAL TANK SEPARATION/ENTRY. VEHICLE INSTRUMENTATION CAN ONLY VERIFY WHEN BOTH PARALLEL PATHS THROUGH THE CHECK VALVES FAIL CLOSED. A SINGLE FAIL CLOSED PATH CANNOT BE VERIFIED.

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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 BACK FLOW OF PROPELLANT VAPORS.

TO LIMIT THE POTENTIAL FOR POPPET SHAFT BINDING OR GENERATION OF CONTAM, 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., PRESSURE DROP, FILTER BUBBLE POINT, INT LEAKAGE AND CLEANLINESS.

OMRSD PERFORMS THE FOLLOWING: REG LEAK AND FUNCTIONAL TESTS FOR EACH FLIGHT AND ON A CONTINGENCY BASIS. A LEAK AND FUNCTIONAL CHECK OF THE CHECK VALVE (EACH POPPET) THE FIRST FLIGHT, FIFTH FLIGHT AND EVERY FIFTH FLIGHT 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 FOR EACH FLIGHT. REGULATOR RESPONSE TESTS EVERY FLIGHT AND ON A CONTINGENCY BASIS. REGULATOR RESPONSE TEST FOR LOW PRESSURE ON A CONTINGENCY BASIS. HELIUM SYSTEM OFF LOADING THE SECOND FLIGHT AND EVERY FLIGHT THEREAFTER. A HELIUM SYSTEM SAMPLE EVERY THIRD FLIGHT AND ON A CONTINGENCY BASIS.

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(C) INSPECTION

RECEIVING INSPECTION
RAW MATERIAL IS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CLEANLINES TO LEVEL 100 FOR MMH AND 100A FOR N2O4 IS VERIFIED BY
INSPECTION. CORROSION PROTECTION IS VERIFIED BY INSPECTION.

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

NONDESTRUCTIVE EVALUATION
WELDS ARE PENETRANT INSPECTED.

CRITICAL PROCESSES
WELDING PER RAG107-027 IS VERIFIED BY INSPECTION AND VISUALLY INSPECTED.

TESTING
ATP IS WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING, PACKAGING, AND STORAGE ENVIRONMENTS 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 AC0131, AB6893, AC0077. 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. OMRSD 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) HAS
OCCURRED. THESE ARE DOCUMENTED ON AB1378 (WSF), AB3452 (WSF) AND
AB7431 (JSC).

(E) OPERATIONAL USE

PROPOSED SOFTWARE FOR 01-8A WILL AUTOMATICALLY CROSSFEED FOR LOW
PROPELLANT TANK PRESSURE DURING ET SEP.

A CONTINGENCY PROCEDURE WOULD BE TO CLOSE THE HE ISO VALVE AND USE THE
SYSTEM IN BLOWDOWN FOR ENTRY UNTIL MINIMUM ENGINE PRESSURE IS REACHED
AT THIS POINT, FEED THE FAILED RCS SYSTEM FROM THE OTHER POD IN
CROSSFEED. ENOUGH PROPELLANT MAY BE LEFT TO PROVIDE A NOMINAL ENTRY.

DURING MOST MISSION PHASES CROSSFEED PLUS BLOWDOWN OF FAILED SYSTEM
WOULD BE ACCEPTABLE FOR A NOMINAL ENTRY.