SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ORBITAL MANEUVER FMEA NO 03-3 -1003 -1 REV: 4/20/88

ASSEMBLY :PRESSURIZATION SUBSYSTEM
P/N RI :MC621-0059
P/N VENDOR:73P620001-1001
QUANTITY :4
:TWO PER POD
:

CRIT. FUNC: 1R
CRIT. HDW: 3

VEHICLE EFFECTIVITY:	102	103	104
	X	X	X

PHASE(S): PL LO X OO X DO X LS

REDUNDANCY SCREEN: A-PASS B-FAIL C-PASS

PREPARED BY:		APPROVED BY:	APPROVED BY (NASA):
DES	D W CARLSON	DES	SSM
REL	C M AKERS	REL	REL
QE	W J SMITH	QE	QE

ITEM:
VALVE, HELIUM ISOLATION, SOLENOID, NORMALLY CLOSED, SPRING LOADED (LV401, 402, 501,502).

FUNCTION:
PARALLEL REDUNDANT VALVES ARE PROVIDED. THEY PREVENT REGULATOR LEAKAGE AND PROPELLANT TANK OVERPRESSURIZATION. GPC POSITION ALLOWS VALVE TO OPEN ON COMMAND FROM THE GPC. OFF-POSITION DURING NON-FIRING PERIODS PREVENTS OPEN BY SPURIOUS SIGNAL. MANUAL ON/OFF-POSITION FOR LAUNCH PRESSURIZATION & ON-ORBIT OMS TO RCS FEED.

FAILURE MODE:
FAILS OPEN, FAILS TO CLOSE, INTERNAL LEAKAGE

CAUSE(S):
FALSE ELECTRICAL SIGNAL, CONTAMINATION, CORROSION, PLATING, OR MATERIAL DEFICIENCY SPRING BREAKS, PILOT POPPET LEAKS, SEAT CRACKS, MOISTURE FREEZES.

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

(A,B) LOSS OF REDUNDANCY - ONE OF 3 ELEMENTS IN FLOW PATH (INCLUDING SERIES REGULATOR STAGES) REGULATORS GO TO LOCK-UP PRESSURE.

(C) NO EFFECT.

(D) NO EFFECT UNLESS MULTIPLE FAILURES OCCUR.

(E) FUNCTIONAL CRITICALITY EFFECT - POSSIBLE LOSS OF CREW/VEHICLE DUE TO POTENTIAL LOSS OF ENTRY CAPABILITY. LOSS OF SERIES ELEMENTS (2 FAILED OPEN REGULATORS) COMBINED WITH AN OPEN FAILURE OF THE SOLENOID VALVE COULD RESULT IN VENTING OF HELIUM OVERBOARD SUCH THAT PROPELLANT REQUIRED FOR ENTRY COULD NOT BE UTILIZED. FAIL OPEN OF SECONDARY REGULATOR NOT DETECTABLE DURING FLIGHT SINCE PRIMARY REGULATOR MAINTAINS CONTROL.

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DISPOSITION & RATIONALE:
(A)DESIGN (B)TEST (C)INSPECTION (D)FAILURE HISTORY (E)OPERATIONAL USE

(A) DESIGN
VALVE IS SPRING LOADED TO THE CLOSED POSITION. REDUNDANT (SERIES) STAG REGULATORS ARE UTILIZED TO THE LIMIT THE IMPACT OF LEAKAGE OR OPE FAILURE MODES. ADDITIONALLY A RELIEF VALVE IS PROVIDED TO PREVEN DOWNSTREAM OVERPRESSURIZATION SHOULD A DOUBLE REGULATOR FAILURE OCCUR THE HELIUM ISOLATION VALVE IS NORMALLY CLOSED DURING NONFIRING PERIODS A 50 - MICRON FILTER IS PROVIDED ON THE INLET AND A 70 - MICRON FILTER O THE OUTLET TO LIMIT THE POSSIBILITY OF CONTAMINATION CAUSING LEAKAGE JAMMING MOVING PARTS OR PLUGGING PILOT CONTROL ORIFICES.

(B) TEST

QUALIFICATION TESTS
(3 UNITS) - RANDOM VIBRATION - 48 MINUTES EACH AXIS (100 MISSIO EQUIVALENT). SHOCK-BENCH AND OPERATIONAL USE. THERMAL- (+210 TO -3 DEGREES F.). ENDURANCE - 480 OPERATIONAL CYCLES (ON-OFF- FLO). BURS TEST - 10000 PSI. ALSO QUALIFIED AS PART OF POD ASSEMBL. - VIBRO- ACOUSTIC TESTING AT JSC (131 EQUIVALENT MISSIONS). HOT-FIRE TES PROGRAM AT WSTF.

ACCEPTANCE TEST
EACH UNIT - PROOF PRESSURE, FUNCTIONAL TESTS, INTERNAL LEAKAGE TEST PERFORMED BEFORE AND AFTER OPERATING CYCLES.

GROUND TURNAROUND
OPERATION OF THE HELIUM ISOLATION VALVE IS VERIFIED AS PART OF TH REGULATION FLOW TEST CONDUCTED PER V43CB0.030/V43CB0.040.
V43CA0.040 PERFORMS SOLENOID ISOLATION VALVE ELECTRICAL VERIFICATION FO THE FIRST FLIGHT.
V43CA0.072 PERFORMS REDUNDANT CIRCUIT VERIFICATION FOR THE ORBITER/PO EVERY FLIGHT.
V43CA0.075 PERFORMS ELECTRICAL INTERFACE VERIFICATION FOR TH ORBITER/POD ON A CONTINGENCY BASIS.
V43CF0.025 PERFORMS HELIUM ACTIVATION EVERY FLIGHT.
V43CB0.010 PERFORMS INTERNAL LEAKAGE CHECKS OF THE ISOLATION VALVE EVER 5 FLIGHTS & ON CONTINGENCY BASIS.
V43CB0.020 PERFORMS INTERNAL LEAKAGE CHECKS OF THE ISOLATION VALVE FO THE FIRST FLIGHT & ON A CONTINGENCY BASIS.
V43CF0.020 VERIFIES VALVE OPERATION & INTERNAL LEAKAGE DURING HELIU SERVICING EVERY FLIGHT.
VALVES ARE USED INDIVIDUALLY DURING PAD PRE-PRESS AND FOR ON ORBIT BURN AND INTERCONNECT.
SYSTEMS FLUIDS ARE ANALYZED FOR COMPLIANCE TO SPECIFICATION REQUIREMENT AND TO VERIFY THAT ANY CONTAMINATION IS WITHIN PRESCRIBED LIMITS.

(C) INSPECTION

RECEIVING INSPECTION
MATERIALS AND PROCESSES CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CLEANLINESS OF COMPONENTS TO LEVEL 100A PRIOR TO ASSEMBLY, CLEANLINESS OF ASSEMBLY TO LEVEL 100A AND CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
MANUFACTURING, ASSEMBLY AND INSTALLATION PROCEDURES ARE VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. DIMENSIONAL AND VISUAL INSPECTION OF ELECTRICAL COMPONENTS IS PERFORMED AT THE LOWEST LEVEL OF ASSEMBLY. VISUAL AND DIMENSIONAL INSPECTION OF COMPONENTS (INCLUDING SEALS FOR DAMAGE) IS PERFORMED DURING FABRICATION. INSPECTION ALSO VERIFIES THAT SEALS ARE NOT DAMAGED DURING ASSEMBLY.

CRITICAL PROCESSES
THE WELDING PROCESS AND VERIFICATION THAT WELDS MEET SPECIFICATION REQUIREMENTS ARE VERIFIED BY INSPECTION

NONDESTRUCTIVE EVALUATION
PENETRANT AND RADIOGRAPHIC INSPECTION OF WELDS ARE VERIFIED BY INSPECTION.

TESTING
TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. FUNCTIONAL TEST OF ELECTRICAL COMPONENTS IS VERIFIED BY INSPECTION. ACCEPTANCE TEST IS VERIFIED BY INSPECTION.

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

(D) FAILURE HISTORY

ONLY ONE INSTANCE OF A PARTIALLY OPEN VALVE OCCURRED. A NUMBER OF LEAKAGE FAILURES DUE TO CONTAMINATION ARE RECORDED. THE MAJOR CORRECTIVE ACTION INCLUDED THE ADDITION OF AN OUTLET FILTER, SYSTEM ASSEMBLY AND REPAIR CONTROL AND CONTAMINATION CONTROLS. THE FAILURE HISTORY IS DETAILED BELOW.

CAR A7238 INDICATES THAT A VALVE FAILED TO CLOSE FULLY DURING SUPPLIER ATP. THIS WAS DUE TO CONTAMINATION WHICH CAUSED THE POPPET TO HANG UP. THE SUPPLIER OPERATION SHEET WAS CHANGED TO REQUIRE INSPECTION FOR BURRS OR OTHER CONTAMINATION USING OPTICAL AIDS.

CAR 09F21 RECORDS A LEAKAGE FAILURE DETECTED DURING FLIGHT. THIS WAS CAUSED BY CONTAMINATION. INSPECTION FOR BURRS AFTER ULTRA SONIC CLEANING WAS ADDED TO THE SUPPLIER PROCESS.

CAR AB1993 RECORDS A LEAKAGE FAILURE DURING SUPPLIER ATP CAUSED BY MOVEMENT OF THE SEAL (COLD FLOW). VALVE CYCLING AND ADDITIONAL PRE-ATP LEAKAGE TESTS WERE ADDED TO THE SUPPLIER PROCESS.

CAR AB9951 RECORDS A LEAKAGE FAILURE DURING SUPPLIER ATP CAUSED BY RAISED AREAS OF CARBIDE CONCENTRATION. VALVE WEAR IN CYCLING AND INSPECTION POINTS WERE ADDED TO THE SUPPLIER PROCESS.

CAR AB4410 RECORDS LEAKAGE FAILURE DUE TO CONTAMINATION. THIS CAR ALSO COVERED AB4707, AB5070, AB6261, AB6681, AN AB6617 (VEHICLE C/O). ADDITIONAL APPLICABLE CAR'S DURING ATP, QUAL AND SYSTEM TESTING INCLUDE A3149, AC8327, AB6617, A9970, AB0649, AC1682 AND AC0969.

CORRECTIVE ACTION INCLUDED THE ADDITION OF AN OUTLET FILTER, CAUTION NOTES FOR REWORK, REVISED LEAK RATE ALLOWABLE, MAINTAINING A PURGE DURING REPAIR OPERATIONS, THE USE OF PROTECTIVE CLOSURES, ELIMINATION OF REVERSE FLOW DURING WELDING OPERATIONS, MORE DETAILED INSPECTION OF PARTS DURING COMPONENT ASSEMBLY, SEQUENTIAL SYSTEM ASSEMBLY AND CLEANING BETWEEN STAGES AND AN OVERALL EMPHASIS ON CLEANLINESS CONTROL.

(E) OPERATIONAL USE

NO ACTION FOR FIRST FAILURE. FOR SUBSEQUENT FAILURE OPERATE TWO ENGINES FROM AFFECTED POD TO MAXIMIZE HELIUM UTILIZATION AND INCREASE ULLAGE VOLUME TO MAXIMIZE BLOWDOWN. ULLAGE BLOWDOWN ADEQUATE FOR DEORBIT AFTER OMS-2 FOR TYPICAL MISSION (APPROX. 60% ULLAGE REQUIRED FOR MAX BLOWDOWN). TYPICAL DEORBIT BURN REQUIRES LESS THAN 30% PROPELLANT.