SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ORBITAL MANEUVER FMEA NO 03-3 -1009 -3 REV: 4/20/88

ASSEMBLY :PRESSURIZATION SUBSYSTEM
P/N RI :MC284-0421-0015, -0016
P/N VENDOR:
QUANTITY :4
:TWO PER POD
:

CRIT. FUNC: 1R
CRIT. HDW: 2

VEHICLE EFFECTIVITY:	102	103	104
	X	X	X

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

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

PREPARED BY:
DES D W CARLSON
REL C M AKERS
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APPROVED BY:
DES
REL
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APPROVED BY (NASA):
SSM
REL
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ITEM:
VALVE, RELIEF, PRESSURE, BURST DISC & POPPET.

FUNCTION:
PROVIDES PRESSURE RELIEF IN EVENT REGULATOR FAILS OPEN OR PROPELLANT PRESSURE RISES DUE TO THERMAL INCREASE. THE S.S. BURST DISC RELIEF PRESSURE IS 303 TO 313 PSI. THE BURST DISC PROTECTS THE RELIEF VALVE FROM PROPELLANT EXPOSURE. THE BURST DISC ACTUATION IS CONTROLLED BY INLET PRESSURE ACTING ON A BELLEVILLE SPRING MECHANISM. THE MAIN POPPET CRACKING PRESSURE IS 286 PSI AND THE MINIMUM RESEAT PRESSURE IS 280 PSI. AMBIENT PRESSURE SENSING (EXTERNAL) IS PROVIDED.

FAILURE MODE:
FAILS OPEN /LEAKS, BURST DISC RUPTURES PREMATURELY.

CAUSE(S):
INCORRECT PRESSURE SETTING, FATIGUE, CORROSION, VIBRATION, SHOCK, MATERIAL DEFECT, BROKEN BELLEVILLE SPRING.

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

(A) LOSS OF REDUNDANCY (LEAKAGE OR OPEN MODE) MAIN POPPET PROVIDES REDUNDANCY.

(B,C,D) NO EFFECT.

(E) FUNCTIONAL CRITICALITY EFFECT - POTENTIAL LOSS OF CREW/VEHICLE. LOSS OF HELIUM OVERBOARD MAY RESULT IN INABILITY TO UTILIZE PROPELLANT REQUIRED FOR DEORBIT OR MAY RESULT IN INABILITY TO CONTROL VEHICLE DURING ENTRY AND LANDING (WT. & C.G). POTENTIAL PROPELLANT TANK STRUCTURAL FAILURE AT LANDING DUE TO EXCESSIVE PROPELLANT REMAINING. (1R EFFECT REQUIRES FAIL OPEN CONDITION FOR BOTH THE BURST DISC AND THE MAIN POPPET). PREMATURE RUPTURE OF BURST DISC IS NOT DETECTABLE ON THE GROUND OR DURING MISSION.

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

(A) DESIGN
THE MAIN POPPET PROVIDES REDUNDANCY TO THE BURST DISC FOR THE FAIL OPEN MODE. BURST DISC & RELIEF VALVE POPPET ARE REDUNDANT FOR EXTERNAL LEAKAGE. A 25 MICRON FILTER DOWNSTREAM OF BURST DISC REDUCES POTENTIAL FOR CONTAMINATION CAUSED LEAKAGE FAILURE. ON-ORBIT BURNS UTILIZE A SINGLE REGULATOR LEG (MINIMIZES POTENTIAL FOR OVERSHOOT). DEORBIT BURN PROCEDURE (DUAL REG OPERATION) OPENS ONE REGULATOR AT A TIME. OMS 1 BURN AND ABORT DUMPS UTILIZE SIMULTANEOUS REGULATOR OPENING.

(B) TEST

QUALIFICATION TEST
(4 UNITS) - RANDOM VIBRATION, SHOCK-MIL-STD-810, 20 G PEAK,THERMAL CYCLE (- 20 TO 150 DEG F). ENDURANCE - 260 CYCLES (RELIEF VALVE), 36,500 CYCLES (BURST DISC), 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, INTERNAL LEAKAGE, CRACK AND RESEAT, CHECK OF PROPER SET POINT OF BURST DISC ACTUATOR, FLOW CAPACITY, CLEANLINESS AND DRYING.

GROUND TURNAROUND
V43CB0.090 REQUIRES BURST DISC LEAK TEST EACH FLIGHT.
V43CB0.100 REQUIRES RELIEF VALVE LEAK, CRACK AND RESEAT FOR EVERY 5TH FLIGHT.

(C) INSPECTION

RECEIVING INSPECTION
MATERIALS AND PROCESSES CERTIFICATION ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CLEANLINESS TO LEVEL 100A FOR RELIEF VALVE INTERNAL FLOW CAVITY AND LEVEL V.C. FOR EXTERNAL SURFACES AND OTHER INTERNAL PARTS IS VERIFIED BY INSPECTION. CORROSION PROTECTION (PASSIVATION AND ECONOCHROME) IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
MANUFACTURING ASSEMBLY AND INSTALLATION PROCEDURES ARE VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. SEAT INSPECTION FOR SURFACE DEFECTS IS VERIFIED BY INSPECTION. TEFLON GUIDE RINGS INSTALLATION AND VERIFICATION OF NO GUIDE STEM BINDING ARE VERIFIED BY INSPECTION. POPPET INSTALLATION INTO VALVE ASSEMBLY IS VERIFIED BY INSPECTION.

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NONDESTRUCTIVE EVALUATION
RADIOGRAPHIC INSPECTION OF WELD #W8 (PER EP55760009) PER MIL-STD-453 IS VERIFIED BY INSPECTION. PENETRANT INSPECTION PER MIL-I-6866 (TYPE I METHOD A OR C), OF WELDS #'S W3, W5, W8, W9 AND W11 IS VERIFIED BY INSPECTION.

CRITICAL PROCESS
THE WELD PROCESS PER EP55760009 IS VERIFIED BY INSPECTION. VISUAL OR 10X MAGNIFICATION INSPECTION OF ALL WELDS IS VERIFIED BY INSPECTION. PROOF PRESSURE TEST AND LEAK TEST OF CERTAIN WELDS IS VERIFIED BY INSPECTION.

TESTING
TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. ACCEPTANCE TEST INCLUDING CLEANLINESS TEST, INTERNAL LEAKAGE TEST TO VERIFY SEAT INTEGRITY, PROPER POPPET OPERATION, PROPER SET POINT OPERATION OF BELLEVILLE WASHER SPRING AND PRESSURE SETTING IS VERIFIED BY INSPECTION.

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

(D) FAILURE HISTORY
NO FLIGHT FAILURES HAVE OCCURRED IN THIS MODE.

CAR AB5231 INDICATES RUPTURE OF THE BURST DISC DUE TO IMPROPER INSTALLATION OF THE BURST DISC ACTUATION TOOL AT THE SUPPLIER. THIS WAS DUE TO OPERATOR FAILURE.

CAR AB4565 RECORDS ACTUATION OF THE BURST DISC AT WSTF DUE TO IMPROPER PROPELLANT TANK LOADING PROCEDURE WHICH ALLOWED PROPELLANT TO BE FORCED INTO THE INLET LOOP TO THE RELIEF VALVE.

CAR AB5275 RECORDS ACTUATION OF THE BURST DISC AT WSTF. NO DEFINITE CAUSE COULD BE DETERMINED ALTHOUGH A PRESSURE SPIKE WAS SUSPECTED. IMPROVED INSTRUMENTATION(FASTER RESPONSE) WAS INCORPORATED INTO THE TEST SET-UP.

CAR AB5222 RECORDS LOW ACTUATION PRESSURE FOR THE BURST DISC DURING SUPPLIER ATP. THE FAILURE WAS ATTRIBUTED TO A PARTICLE LODGED BETWEEN THE BELLOWS END FITTING AND STOP WHICH SUBSEQUENTLY WORKED FREE CAUSING A CHANGE IN ACTUATION PRESSURE. A CHANGE WAS MADE TO THE BELLOWS DIMENSIONAL CLEARANCE AND A PRE-ATP CYCLE TEST WAS INCORPORATED.

CAR AB5367 RECORDS LEAKAGE THROUGH THE BURST DISC DUE TO CORROSION DURING RCS TESTING AT WSTF (CORROSIVE CELL DUE TO METALLIC PARTICLE OR OTHER CONTAMINANT). CORROSION RESULTED IN PINHOLE IN DISC. CORRECTIVE ACTION WAS TO COAT THE DISC WITH KRYTOX TO INHIBIT CORROSION. FLIGHT UNIT AND SPARES REPLACEMENT ACCOMPLISHED BY MR6556.

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(E) OPERATIONAL USE
NO ACTION FOR FIRST FAILURE NOT DETECTABLE. IF RELIEF VALVE AND BURS DISC FAIL OPEN OR LEAK, USE PERIGEE ADJUST BURN TO DEPLETE PROPELLAN FROM LEAKING POD (OUT OF PLANE COMPONENT IF NECESSARY) AND REDUCE DELTA REQUIREMENT FOR DEORBIT. IF LEAK RATE EXCESSIVE, USE MIXED CROSSFEE DEORBIT BURN FOR ISOLATABLE LEAK (OXIDIZER SIDE). FOR FUEL SIDE LEA PERFORM DEORBIT WITH OTHER POD (YCG OFFSET).