

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ORBITAL MANEUVER FMEA NO 03-3 -1009 -2 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: 3

VEHICLE 102 103 104

EFFECTIVITY: X X X

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

PREPARED BY:

DES D W CARLSON

REL C M AKERS

QE W J SMITH

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

APPROVED BY:

DES

REL

QE

APPROVED BY (NASA):

SSM

REL

QE

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 CLOSED, BURST DISC DOES NOT RUPTURE.

CAUSE(S):

CHANGE IN BURST DISC OR BELLEVILLE SPRING PRESSURE SETTING OR MATERIAL PROBLEM, BELLEVILLE FRACTURE, STRESS CORROSION, GUIDE STEM HANG-UP.

EFFECT(S) ON:

(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE

(A) LOSS OF SUBSYSTEM RELIEF CAPABILITY - NO EFFECT UNLESS MULTIPLE FAILURES OCCUR (TWO REGULATOR STAGES FAIL OPEN) OR SUDDEN PRESSURE INCREASE OCCURS DUE TO TEMPERATURE (IMPROBABLE).

(B,C,D) NO EFFECT.

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(E) FUNCTIONAL CRITICALITY EFFECT - POSSIBLE LOSS OF CREW/VEHICLE. RELIEF VALVE FAILED CLOSED COULD RESULT IN PROPELLANT TANK RUPTURE IF SERIES REGULATOR (2 FAILED OPEN ELEMENTS) FAILS OPEN. BURST DISC FUNCTION CANNOT BE VERIFIED AFTER INSTALLATION IN POD.

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. FOR THE EFFECT OF RE-ENTRY HEAT SOAK BACK ON THE LOW PROPELLANT MASS REMAINING, THE POST LANDING PURGE AND VENT REQUIREMENTS RELIEVE PRESSURE BUILD-UP AFTER LANDING. SERIES REGULATORS PROVIDE REDUNDANCY FOR FAIL OPEN REGULATOR. REGULATOR FLOW LIMITER LIMITS MAXIMUM FLOWRATE FROM FAILED OPEN REGULATOR TO 1040 SCFM. HELIUM ISOLATION VALVES ISOLATE HELIUM TANK PRESSURE FROM REGULATORS EXCEPT DURING OMS BURN OPERATIONS OR RCS INTERCONNECT OPERATIONS. EXCESSIVE VILLAGE PRESSURE TRIGGERS CAUTION AND WARNING ALERT.

(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 RESEAL, SET POINT OF ACTUATOR, FLOW CAPACITY, CLEANLINESS AND DRYING.

GROUND TURNAROUND

NO GROUND CHECKOUT OF BURST DISC FUNCTION PERFORMED, TOOL USED AT VENDOR FOR VERIFICATION OF BURST DISC FUNCTION NOT USABLE ON VEHICLE.

(C) INSPECTION

RECEIVING INSPECTION

MATERIALS AND PROCESSES CERTIFICATIONS 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.

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ASSEMBLY/INSTALLATION

MANUFACTURING, ASSEMBLY AND INSTALLATION PROCEDURES ARE VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. TEFLON GUIDE RING INSTALLATION AND VERIFICATION OF NO GUIDE STEM BINDING IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

RADIOGRAPHIC INSPECTION OF WELD NUMBER W8 (PER EPS5760009) PER MIL-STD-453 IS VERIFIED BY INSPECTION. PENETRANT INSPECTION PER MIL-I-6866 (TYPE I, METHOD A OR C), OF WELD NUMBERS W3, W5, W8, AND W11 IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

THE WELD PROCESS PER EPS5760009 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 (INTERNAL LEAKAGE TEST, PROPER SET POINT OPERATION OF BELLEVILLE WASHER SPRING AND PRESSURE SETTING FOR BURST DISC ACTUATION) IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

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

(D) FAILURE HISTORY

CAR AB4070: (QUAL)

THE RCS RELIEF VALVE BURST DISC RUPTURED AT 350 PSIG (THE SPECIFICATION REQUIREMENT IS 332 +/- 8 PSIG). THIS WAS ATTRIBUTED TO CONDENSATION WHICH FORMED DURING A LONG INTERRUPTION OF THE QUAL TEST AND SUBSEQUENT FREEZING DURING THE LOW TEMPERATURE TEST. CORRECTIVE ACTION - NOT REQUIRED; POD HEATERS PRECLUDE FREEZING CONDITIONS.

CAR AB3473 (QUAL)

THE RCS RELIEF VALVE BURST DISC ACTUATED AT 343 PSIG FOLLOWING A RANDOM VIBRATION TEST. THIS FAILURE DID NOT REPEAT DURING RETEST. THIS WAS ATTRIBUTED TO A TWISTING ACTION OF THE BURST DISC BELLOWS THAT AFFECTED INITIAL ACTUATION OF THE UNIT.

CAR AB3493 RECORDS A SIMILAR FAILURE WHICH OCCURRED DURING TESTING OF THE OMS HELIUM PRESSURE RELIEF VALVE. THIS UNIT ACTUATED AT 313.5 PSIG (0.5 ABOVE MAX ALLOWABLE).

NO ACTION WAS TAKEN SINCE THESE MINOR EXCURSIONS WOULD NOT AFFECT SYSTEM PERFORMANCE NOR ARE THE DURATIONS OF VIBRATION (100 MISSIONS X 4) ANTICIPATED DURING MISSION.

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(E) OPERATIONAL USE

CLOSE HELIUM ISOLATION VALVE WHEN ALERTED TO EXCESSIVE TANK USAGE  
PRESSURE BY C&W. PERFORM REMAINING MISSION REQUIREMENTS USING PARALLEL  
LEG OF HELIUM SYSTEM. ONE LEG WILL SUPPORT ALL MISSION REQUIREMENTS.