SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :AFT - REACTION CONTROL FMEA NO 03-2A -201060 -3 REV:04/28/86

ASSEMBLY :PRESSURIZATION SUBSYSTEM
P/N RI :MC284-0421-0011, -0012
P/N VENDOR:576009-111,-112
QUANTITY :4
:2 PER POD
:1 PER PROPELLANT

CRIT. FUNC: 1R
CRIT. HDW: 3

VEHICLE EFFECTIVITY:	102	103	104
	X	X	X

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

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

PREPARED BY:		APPROVED BY:	APPROVED BY (NASA):
DES	J LAZARUS	DES	SSMA
REL	R P DIEHL	REL	REL
QE	W J SMITH	QE	QE

ITEM:
VALVE RELIEF, PRESSURE, BURST DISC & POPPET (RV201, 202, 301, 302).

FUNCTION:
PROVIDES PRESSURE RELIEF IN EVENT REGULATOR FAILS OPEN OR PROPELLANT PRESSURE RISES DUE TO THERMAL INCREASE. THE S/S BURST DISC RUPTURE PRESSURE IS 324 TO 340 PSI. THE MAIN POPPET MINIMUM CRACKING PRESSURE IS 315 PSI AND THE MINIMUM RESEAT PRESSURE IS 310 PSI. AMBIENT PRESSURE SENSING (EXTERNAL) IS PROVIDED. STAINLESS STEEL BURST DISK ASSEMBLY CONTROLLED BY INLET PRESSURE ACTING ON BELLEVILLE SPRING PROTECTS RELIEF VALVE FROM PROPELLANT EXPOSURE.

FAILURE MODE:
FAILS OUT OF TOLERANCE: BURST DISC DOES NOT RUPTURE AS REQUIRED.

CAUSE(S):
STRESS CORROSION, IMPROPER INSTALLATION/HANDLING, FATIGUE, MAT'L DEF, STRUCTURAL FAILURE, POPPET BINDS IN GUIDE, DIAPHRAGM FRACTURE, BELLEVILLE FRACTURE, BELLOWS LEAK CAUSING PROPELLANT EXPOSURE TO BELLEVILLE HOUSING.

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

(A) NO EFFECT UNLESS MULTIPLE FAILURES OCCUR.

(B) NO EFFECT

(C) NO EFFECT

(D) NO EFFECT

(E) FUNCTIONAL CRITICALITY EFFECT - POSSIBLE LOSS OF CREW/VEHICLE DUE TO OVERPRESSURIZATION OF PROP TANKS. REQUIRES FAILURE OF BOTH REG STAGES WITH SOLENOID VALVE OPEN. LIMITED TIME TO TAKE CORRECTIVE ACTION. UNABLE TO CHECK BURST DISK ON GROUND WITHOUT RUPTURING.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :AFT - REACTION CONTROL FMEA NO 03-2A -201060 -3 REV:12/03/87

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

(A) DESIGN
THE FACTOR OF SAFETY FOR IS 1.5 FOR PROOF PRESSURE AND 2.0 FOR BURST PRESSURE.

THE MECHANISM DESIGN, INCLUDING DIMENSIONAL TOLERANCES OF THICKNESS OF THE DISKS AND BELLOWS DIAMETER, INSURES PROPER PRESSURE FORCE IS AVAILABLE AND DISK WILL RUPTURE.

SERIES REGULATORS PROVIDE REDUNDANCY FOR FAIL OPEN REGULATOR. FOR ANY EFFECT OF OF RE-ENTRY HEAT SOAK BACK ON LOW PROPELLANT MASS REMAINING, THE POST LANDING PURGE AND VENT REQUIREMENTS RELIEVE PRESSURE BUILD-UP AFTER LANDING. EXCESSIVE ULLAGE PRESSURE TRIGGERS A CAUTION AND WARNING ALERT AND THE HELIUM ISOLATION VALVE CAN BE USED TO ISOLATE HELIUM TANK PRESSURE.

(B) TEST
THE QUALIFICATION TEST PROGRAM INCLUDED RANDOM VIBRATION, SHOCK (PER MIL-STD-810 20g PEAK), THERMAL CYCLE (+20 TO +150 DEG F), ENDURANCE CYCLES-RELIEF VALVE AND 36,500 CYCLES FOR THE BURST DISK), AND PROPEL COMPATIBILITY.

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

ACCEPTANCE TESTING INCLUDES PROOF PRESSURE, EXTERNAL LEAKAGE, INTERNAL LEAKAGE, CRACKING AND RESEAT PRESSURE, FLOW CAPACITY, CLEANLINESS AND DRYING, PROOF AND LEAK TESTING OF WELDED JOINTS OF THE BELLOWS, AND CHECKING OF PROPER SET POINT OF THE BURST DISK ACTUATION.

OMRSD: NO GROUND CHECKOUT OF THE BURST DISK FUNCTION IS PERFORMED. THE TOOL USED AT THE SUPPLIER'S FACILITY FOR VERIFICATION OF THE BURST DISK FUNCTION IS NOT USABLE ON THE VEHICLE.

(C) INSPECTION

RECEIVING INSPECTION
TEST REPORTS AND RAW MATERIAL CERTIFICATIONS CERTIFYING MATERIALS AND PHYSICAL PROPERTIES ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CLEANLINESS OF THE RELIEF VALVE INTERNAL FLOW CAVITY TO LEVEL 100 FOR TH MC284-0421-0011 AND LEVEL 100A FOR THE MC284-0421-0012 AND CORROSION PROTECTION ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
DIMENSIONAL AND VISUAL INSPECTION IS VERIFIED BY INSPECTION. MANUFACTURING PROCESSES, INSTALLATION, AND ASSEMBLY OPERATIONS ARE VERIFIED BY INSPECTION. TEFLON GUIDE RING INSTALLATION IS VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY

INSPECTION. SEAT IS VERIFIED BY INSPECTION TO BE FREE OF SURFACE DEFECTS AND CRACKS PRIOR TO ASSEMBLY.

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 1, METHOD A OR C, OF WELD NUMBER W3, W5, W8, W9, AND W11 (PER EPS5760009) IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
WELDING PER EPS5760009 IS VERIFIED BY INSPECTION. VISUAL OR 10X MAGNIFICATION INSPECTION OF ALL WELDS PER EPS5760009 IS VERIFIED BY INSPECTION. PROOF PRESSURE TEST AND LEAK TEST OF CERTAIN WELDS IS VERIFIED BY INSPECTION.

TESTING
ATP IS WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PACKAGING OF THE FINAL ASSEMBLY FOR SHIPMENT PER 1EPS5760009 IS VERIFIED BY INSPECTION. HANDLING AND STORAGE REQUIREMENTS ARE VERIFIED BY INSPECTION. RETURNED AND ACCEPTED GOODS ARE KEPT IN BONDED AREAS AND VERIFIED BY INSPECTION.

(D) FAILURE HISTORY
NO INSTANCES OF A RELIEF VALVE FAILING CLOSED HAVE OCCURRED. INSTANCES OF SLIGHTLY HIGH RELIEF PRESSURE HAVE OCCURRED. TWO FAILURES ARE RECORDED FOR THE RCS DURING QUALIFICATION TEST. (REFERENCE AB4070 AND AB3473). IN ONE CASE (AB4070) THE 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.

IN THE OTHER CASE (AB3473) THE BURST DISC ACTUATED AT 343 PSIG FOLLOWING RANDOM VIBRATION TEST. THIS LATTER FAILURE DID NOT REPEAT DURING RETEST. THIS WAS ATTRIBUTED TO A TWISTING ACTION ON THE BURST DISC BELLOWS THAT AFFECTED INITIAL ACTUATION OF THE UNIT.

A SIMILAR FAILURE DURING TESTING OF THE OMS HELIUM PRESSURE RELIEF VALVE IS RECORDED ON CAR AB3493. 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.

(E) OPERATIONAL USE
CREW MAY BE ABLE TO CLOSE HELIUM ISOLATION VALVE PRIOR TO PROPELLANT TANK RUPTURE. IF AFTER HELIUM ISO VALVE CLOSURE THE PROPELLANT TANK PRESSURE EXCEEDS THE TANK LIMIT, THE CREW MAY FIRE RCS ENGINES TO BRING TANK PRESSURE BELOW HIGH LIMIT . THIS IS NOT A MISSION RULE.

IN OPS 2 AUTOMATIC CLOSURE OF HELIUM ISO VALVES OCCURS IF PRESSURE IN PROP TANK EXCEEDS 300 PSIA. TIME TO CLOSURE IS GREATER THAN 3 SECONDS AFTER PRESSURE LIMIT IS EXCEEDED.