

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :AFT - REACTION CONTROL FMEA NO 03-2A -201060 -5 REV:04/25/88

ASSEMBLY :PRESSURIZATION SUBSYSTEM CRIT. FUNC: 1R
P/N RI :MC284-0421-0011,-0012 CRIT. HDW: 2
P/N VENDOR:5760009-111,-112 VEHICLE 102 103 104
QUANTITY :4 EFFECTIVITY: X X X
:2 PER POD PHASE(S): PL LO X OO X DO X LS
:1 PER PROPELLANT

REDUNDANCY SCREEN: A-PASS B-FAIL C-PASS
PREPARED BY: APPROVED BY: APPROVED BY (NASA):
DES J LAZARUS DES R. D. [Signature] SSM [Signature]
REL R P DIEHL REL [Signature] REL [Signature]
QE W J SMITH QE [Signature] QE [Signature]

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 324 TO 340 PSI. MAIN POPPET MIN CRACKING PRESSURE IS 315 PSI. AND THE MINIMUM RESEAT PRESSURE IS 310 PSI. AMBIENT PRESSURE SENSING (EXTERNAL) IS PROVIDED SINCE THE VALVE OUTLET IS SUBJECTED TO BACK-PRESSURE. STAINLESS STEEL BURST DISK ASSEMBLY CONTROLLED BY INLET PRESSURE ACTING ON BELLEVILLE SPRING PROTECTS RELIEF VALVE FROM PROPELLANT EXPOSURE.

FAILURE MODE:
BURST DISK RUPTURES PREMATURELY, BURST DISC LEAKS

CAUSE(S):
INCORRECT PRESSURE SETTING, FATIGUE, SHOCK, EXCESS PRESSURE CYCLING, VIBRATION, MAT'L DEFECT.

EFFECT(S) ON:
(A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE
(A) LOSS OF REDUNDANCY FOR HELIUM LEAKAGE, RELIEF VALVE'S MAIN POPPET PROVIDES REDUNDANCY. RELIEF VALVE WOULD BE EXPOSED TO HELIUM WHICH IS SATURATED WITH PROPELLANT VAPOR.
(B) NO EFFECT
(C) NO EFFECT
(D) NO EFFECT

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(E) FUNCTIONAL CRITICALITY EFFECT - POSSIBLE LOSS OF CREW/VEHICLE IF ULLAGE PRESSURE IS DEPLETED. INABILITY TO PERFORM MATED COAST/ET SEP/ ENTRY DUE TO LOSS OF PROPELLANT TANK PRESSURIZATION. BURST DISK RUPTURE ON-ORBIT CANNOT BE VERIFIED DUE TO LACK OF INSTRUMENTATION IN OVERBOARD VENT LINES.

DISPOSITION & RATIONALE:

(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE

(A) DESIGN

THE BURST DISK AND RELIEF VALVE POPPET ARE REDUNDANT FOR EXTERNAL LEAKAGE. A 25 MICRON FILTER DOWNSTREAM OF THE BURST DISK REDUCES THE POTENTIAL FOR CONTAMINATION CAUSED LEAKAGE FAILURES.

THE MAIN POPPET STEM IS A SEPARATE PIECE FROM THE MAIN SENSING SPRING ACTUATION MECHANISM. THIS PROVIDES CLOSE TOLERANCE CONTROL OF OPENING SPRING FORCE. THE VALVE MATERIALS ARE ALL COMPATIBLE WITH PROPELLANT.

(B) TEST

THE QUALIFICATION TEST PROGRAM INCLUDED RANDOM VIBRATION, SHOCK (PER MIL-STD 810 20g PEAK), THERMAL CYCLE (+20 TO +150 DEG F), ENDURANCE (80 CYCLES RELIEF VALVE AND 36,500 CYCLES FOR THE BURST DISK), AND PROPELLANT COMPATIBILITY.

THE UNIT WAS ALSO 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 SEVEN YEARS OF PROPELLANT EXPOSURE.

THE VALVE ACCEPTANCE TESTING INCLUDES PROOF PRESSURE, EXTERNAL LEAKAGE, INTERNAL LEAKAGE, RUPTURE PRESSURE SETTING, 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 ACTUATOR.

OMRSD PERFORMS THE FOLLOWING: A BURST DISK LEAK TEST EVERY MISSION. A RELIEF VALVE LEAK/FUNCTIONAL TEST THE FIRST FLIGHT, THE FIFTH FLIGHT AND EVERY FIVE FLIGHTS THEREAFTER AND ON A CONTINGENCY BASIS.

(C) INSPECTION

RECEIVING INSPECTION

RAW MATERIAL AND PHYSICAL PROPERTIES ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS OF THE RELIEF VALVE INTERNAL FLOW CAVITY TO 100 FOR THE MC2B4-0421-0011 AND LEVEL 100A FOR THE MC2B4-0421-0012 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

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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 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 SUPPLIER ATP. THE FAILURE WAS ATTRIBUTED TO A PARTICLE LODGED BETWEEN THE BELLOW END FITTING AND STOP WHICH SUBSEQUENTLY WORKED FREE CAUSING A CHANGE IN ACTUATION PRESSURE. A CHANGE WAS MADE TO THE BELLONS DIMENSIONAL CLEARANCE AND PRE-ATP CYCLE TEST WAS INCORPORATED.

(E) OPERATIONAL USE

NO ACTION FOR FIRST FAILURE. IF SECOND FAILURE IS BEFORE ET SEP USE CROSSFEED. FOR NOTICEABLE LEAK RATES ON-ORBIT DUMP ONBOARD PROPELLANT.

FOR ENTRY USE CROSSFEED. THIS MAY NOT BE SUFFICIENT PROPELLANT FOR NOMINAL ENTRY. IF THE LEAK OCCURS DURING ENTRY USE FAILED SYS DOWN TO ZERO PVT. SWITCH TO CROSSFEED FOR THE REMAINDER OF ENTRY.