

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ATMOSPHERIC REVIT. FMEA NO 06-1C -0206 -1 REV:09/13/88

ASSEMBLY :ATMOS VENTING CONTROL CRIT. FUNC: 1R
P/N RI :MC250-0002-0075 CRIT. HDW: 2
P/N VENDOR:2725-0001-3 CARLETON VEHICLE 102 103 104
QUANTITY :2 EFFECTIVITY: X X X
:TWO PER SUBSYSTEM PHASE(S): PL LO OO DO X LS
:

PREPARED BY: DES N. PRICE
REL N. L. STEISLINGER
QE S. MOR

REDUNDANCY SCREEN: A-PASS B-N/A C-PASS
APPROVED BY: (BASE):
SSM
REL
QE

DES N. PRICE
REL N. L. STEISLINGER
QE S. MOR

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ITEM:
RELIEF VALVE - CABIN NEGATIVE PRESSURE

FUNCTION:
TWO VALVES MOUNTED FOR PARALLEL FLOW, EACH OF WHICH ALLOWS SUFFICIENT FLOW INTO CABIN TO MAINTAIN THE CABIN CRUSHING PRESSURE AT LESS THAN 1.0 PSID DURING DEPRESSURIZED CABIN RE-ENTRY CONDITIONS. BEGINS TO FLOW AT MAXIMUM NEGATIVE PRESSURE DIFFERENTIAL OF 0.25 PSID AND MAXIMUM FULL OPEN IS AT 0.5 PSID. THE RELIEF VALVE CONTAINS A SEALING CAP INTEGRAL TO ITS ASSEMBLY. VALVES ARE MOUNTED ON THE LEFT HAND SIDE OF THE ORBITER, BELOW THE CREW HATCH, WITH A SINGLE O-RING SEAL (REF. FMEA 01-4-CS45-1).

FAILURE MODE:
INABILITY TO RELIEVE

CAUSE(S):
MECHANICAL SHOCK, VIBRATION, CORROSION, CONTAMINATION, PHYSICAL BINDING/JAMMING

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

(A) LOSS OF REDUNDANCY - ONE VALVE REMAINS TO REPRESSURIZE CABIN.
(B) NO EFFECT. REDUNDANT VALVE WILL PROVIDE ADEQUATE FLOW.
(C) NO EFFECT. VALVES ARE ONLY REQUIRED DURING DE-ORBIT.
(D) NO EFFECT. ONLY ONE VALVE IS NEEDED TO REPRESSURIZE THE CABIN.
(E) FUNCTIONAL CRITICALITY EFFECT - SECOND ASSOCIATED FAILURE (FAILURE OF REDUNDANT VALVE) DURING DE-ORBIT WITH REDUCED CABIN PRESSURE WOULD RESULT IN EXCESSIVE CRUSHING PRESSURE ON THE CABIN AND POSSIBLE LOSS OF CREW/VEHICLE. SCREEN B IS N/A BY DEFINITION FOR STANDBY REDUNDANCY OF RELIEF VALVES.

126

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SUBSYSTEM : ATMOSPHERIC REVIT. FMEA NO 06-1C -0206 -1 REV:09/13/8

DISPOSITION & RATIONALE:

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

(A) DESIGN

THE VALVE BODY IS MADE OF 6061-T6 ALUMINUM ALLOY, ANODIZED FOR CORROSION. THE RELIEF VALVE IS OF PRIMARY POPPET CONSTRUCTION AND INCORPORATES A CAPTIVE REDUNDANT VALVE COVER WHICH PROVIDES ASSURANCE AGAINST CABIN OUTFLOW RESULTING FROM A PRIMARY POPPET FAILURE. THE PRIMARY POPPET COMPRISES A CIRCULAR VALVE HEAD WITH A SILASTIC 675 SILICONE RUBBER SEAL AND INTEGRAL POLISHED VALVE SHAFT WHICH RIDES IN A TUBULAR BORE OF THE VALVE HOUSING. SILASTIC 675 SILICONE RUBBER HAS GOOD RESISTANCE TO ENVIRONMENTAL EXPOSURE, FLEXING, AND FATIGUE. IT ALSO HAS LOW FLAMMABILITY AND OUTGASSING. THE OZONE RESISTANCE OF SILICONE RUBBER IS EXCELLENT. THE PRIMARY POPPET SHAFT AND VALVE BODY BORE ARE BOTH TEFLON IMPREGNATED HARD ANODIZED TO REDUCE FRICTION. DEBRIS SCREEN PROTECTS AGAINST DEBRIS INJECTION AND RESULTANT LEAKAGE PROBLEMS.

(B) TEST

ACCEPTANCE TEST - PER ATP 2725-3. PROOF PRESSURE TEST - PERFORMED WITH COVER OFF/POPPET CLOSED AND WITH COVER ON/POPPET OPEN; PRESSURE 25 PSIG. LEAKAGE TEST - WITH COVER ON/POPPET OPEN AND WITH COVER OFF/POPPET CLOSED; PRESSURE 15 PSIG, MAX LEAKAGE 15 SCCM. CRACKING PRESSURE 0.2 PSID MINIMUM. MINIMUM FLOW AT 0.5 PSID, 3600 LB/HR.

QUALIFICATION TEST - PER QTP 2725-3. BURST PRESSURE - 32 PSID ACROSS THE VALVE POPPET AND ACROSS THE COVER (POPPET HELD OPEN). DESIGN SHOCK - 20 G TERMINAL SAWTOOTH PULSE OF 11 MS DURATION IN EACH DIRECTION OF THE ORTHOGONAL AXES. RANDOM VIBRATION SPECTRUM - 30 TO 150 HZ INCREASING AT 6 DB/OCTAVE TO 0.09 G**2/HZ, CONSTANT AT 0.09 G**2/HZ FROM 150 TO 900 HZ, DECREASING AT 9 DB/OCTAVE FROM 900 TO 2000 HZ FOR 48 MINUTES PER AXIS. AT THE END OF 17 MINUTES VIBRATION, THE VALVE WAS PRESSURIZED TO 2 PSIG AND LEAKAGE WAS MONITORED FOR 17 MINUTES. AT THE LAST 17 MINUTES, PRESSURE WAS INCREASED TO 14 PSIG AND LEAKAGE WAS MONITORED FOR THE LAST 14 MINUTES OF VIBRATION. MAX ALLOWABLE LEAKAGE WAS 15 SCCM. SINUSOIDAL VIBRATION - 5 - 35 HZ AT AN ACCELERATION AMPLITUDE OF +/- 0.25 G PEAK IN THREE ORTHOGONAL AXES; DURATION CONTROLLED BY A ONE OCTAVE PER MINUTE SWEEP RATE. THERMAL VACUUM TEST WAS CONDUCTED AT 1×10^{-6} TORR, WITH TEMPERATURE CYCLED THREE TIMES BETWEEN -65 F AND + 200 F. LIFE CYCLE TEST - 200 CYCLES OF RELIEF VALVE OPEN FULL STROKE/RESEAT. ATP TO VERIFY LEAKAGE IS PERFORMED AFTER SHOCK AND VIBRATION TESTING.

IN-VEHICLE TESTING - RELIEF VALVE CRACK TEST IS PERFORMED AT 0.2 - 0.5 PSID. POPPET FULL TEST IS ALSO PERFORMED.

ORSD - RELIEF VALVE CRACK TEST IS PERFORMED BEFORE THE FIRST REFLIGHT OF EACH ORBITER AND AT INTERVALS OF FIVE FLIGHTS AT 0.2 - 0.5 PSID. POPPET FULL TEST IS ALSO PERFORMED.

(C) INSPECTION

RECEIVING INSPECTION

RAW MATERIAL VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

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CONTAMINATION CONTROL
CORROSION PROTECTION PROVISIONS AND CONTAMINATION CONTROL PLAN ARE VERIFIED BY INSPECTION. CLEANLINESS LEVEL 200A PER MAC110-301 AND 100ML RINSE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
PARTS PROTECTION FROM DAMAGE AND CONTAMINATION IS VERIFIED. TORQUES ARE VERIFIED. DIMENSIONAL CHECKS ARE PERFORMED BY INSPECTION. VISUAL INSPECTION USING 10X MAGNIFICATION ON SEAL RING VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
BRAZING AND WELDING CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES
HEAT TREAT, PARTS PASSIVATION AND HARD ANODIZING ARE VERIFIED BY INSPECTION. LUBRICANT APPLICATION ON SEAL RING VERIFIED BY INSPECTION. SOLDER CONNECTIONS VERIFIED BY INSPECTION.

TESTING
ATP VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING, PACKAGING, STORAGE AND SHIPPING PROCEDURES ARE VERIFIED.

(D) FAILURE HISTORY
NO FAILURE HISTORY APPLICABLE TO INABILITY TO RELIEVE FAILURE MODE. THE RELIEF VALVE HAS SUCCESSFULLY BEEN USED THROUGH THE SHUTTLE PROGRAM CONSIDERING THIS FAILURE MODE.

(E) OPERATIONAL USE
TBS.