

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ATMOSPHERIC REVIT. FMEA NO 06-1C -0206 -3 REV: 01/06/88

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

PREPARED BY: DES M. PRICE *WJP*
REL N. L. STEISSLINGER *NLS*
QE W. J. SMITH

REDUNDANCY SCREEN: A- B- C-
APPROVED BY: DES *[Signature]* APPROVED BY (NASA):
REL *[Signature]* SSM *[Signature]*
QE *[Signature]* REL *[Signature]* 7/28

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:
EXTERNAL LEAKAGE (CRACKED MOUNTING FLANGE)

CAUSE(S):
MATERIAL DEFECT, MECHANICAL SHOCK, VIBRATION

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

(A) EXCESSIVE LOSS OF CABIN ATMOSPHERE.
(B) INCREASED USE OF N2/O2 MAKE-UP GASES.
(C) ABORT DECISION - MISSION TERMINATION BASED ON MAGNITUDE OF LEAK.
(D) POSSIBLE LOSS OF CREW/VEHICLE IF EQUIVALENT HOLE SIZE IS GREATER THAN 0.45 INCH. RETURN REQUIRED WITH EMERGENCY 8.0 PSIA CABIN PRESSURE MAINTENANCE.

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

(A) DESIGN
THE PORTION OF THE VALVE BEING CONSIDERED AS CRITICALITY 1/1 IS THE MOUNTING FLANGE. CRACKS ELSEWHERE IN THE VALVE ARE PROTECTED BY ONE OR MORE REDUNDANT SEALS; E.G., SILASTIC 675 STATIC SEALS AND VESPEL SP-1 VALVE SEAT. THE MOUNTING FLANGE IS MADE OF 6061-T6 ALUMINUM ALLOY ANODIZED FOR CORROSION RESISTANCE. CRACK PROPAGATION IS CONSIDERED TO BE

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HIGHLY UNLIKELY IN THE CRITICALITY 1/1 PORTION OF THE FLANGE SINCE IT WOULD HAVE TO GO FROM THE BOLT HOLE AREA RADially THROUGH THE FLANGE, PAST THE O-RING GROOVE AND INWARD OR OUTBOARD, COMPLETELY THROUGH THE FLANGE. 32 RMS FINISH ON MOUNTING FLANGE MINIMIZES LEAKAGE AT PENETRATION.

(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.

QUALIFICATION TEST - PER QTP 2725-3. BURST PRESSURE - 32 PSID ACROSS THE VALVE POPPET AND ACROSS THE COVER (POPPET HELD OPEN). FACTOR OF SAFETY = 2. DESIGN SHOCK - 20 G TERMINAL SAWTOOTH PULSE OF 11 MS DURATION IN EACH DIRECTION OF THREE ORTHOGONAL AXES. RANDOM VIBRATION SPECTRUM - 20 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 X 10 EXP -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 - 3.2 PSID CABIN LEAK TEST.

OMRSD - 3.2 PSID CABIN LEAK TEST PERFORMED BEFORE FIRST REFLIGHT OF EACH ORBITER. A 2 PSID CABIN INTEGRITY TEST IS PERFORMED BEFORE EACH LAUNCH. FLIGHT DATA WILL BE UTILIZED DURING EACH MISSION TO ASSESS OCCURRENCE OF ANY EXCESSIVE EXTERNAL LEAKAGE.

(C) INSPECTION

RECEIVING INSPECTION

RAW MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL

CORROSION PROTECTION PROVISIONS AND CONTAMINATION CONTROL PLAN ARE VERIFIED BY INSPECTION. CLEANLINESS LEVEL 200A PER MA0110-301 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

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CRITICAL PROCESSES

HEAT TREAT AND ANODIZING ARE VERIFIED BY INSPECTION. LUBRICANT APPLICATION ON SEAL RING VERIFIED BY INSPECTION. SOLDER CONNECTIONS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

BRAZING AND WELDING CERTIFICATIONS ARE VERIFIED BY INSPECTION.

TESTING

ATP VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING FOR SHIPMENT VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

NO FAILURE HISTORY APPLICABLE TO EXTERNAL LEAKAGE FAILURE MODE. THE RELIEF VALVE HAS SUCCESSFULLY BEEN USED THROUGH THE SHUTTLE PROGRAM FOR THIS FAILURE MODE.

(E) OPERATIONAL USE

1. CREW ACTION

PERFORM CREW MODULE LEAK TROUBLESHOOTING AND APPROPRIATE FOLLOW-UP ACTION (E.G. POWERDOWN).

2. TRAINING

STANDARD ECLSS TRAINING COVERS THE EFFECT OF DECREASING CABIN PRESSURE AND THE NECESSARY ACTION DICTATED BY THE SIZE OF THE LEAK (E.G. POWERDOWN, MISSION TERMINATION).

3. OPERATIONAL CONSIDERATION

A. TIME REMAINING IN MISSION IS PROPORTIONAL TO THE N2 QUANTITY REMAINING ON BOARD AND LEAK RATE.

B. REFERENCE LOSS/FAILURE FLIGHT RULES.

C. CURRENT FLIGHT DATA FILE PROCEDURES PROPERLY COVER THIS FAILURE AND FOLLOW-UP ACTION.