

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE  
NUMBER: 06-1C-0201 -X

SUBSYSTEM NAME: ARS - ARPCS

REVISION: 8 10/27/98

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**PART DATA**


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	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: RV, CABIN POSITIVE PRESSURE CARLETON TECHNOLOGIES	MC250-0002-0250 2655-0001-15

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
CABIN POSITIVE PRESSURE RELIEF VALVE ASSEMBLY (RELIEF AND ISOLATION VALVES)

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 2

**FUNCTION:**

VALVE HAS TWO SECTIONS WHICH WORK IN SERIES. THE FRONT SECTION IS A MOTOR DRIVEN BUTTERFLY VALVE AND PROVIDES ISOLATION OF THE RELIEF SECTION. THE RELIEF SECTION VENTS AT CABIN PRESSURE BETWEEN 15.5 AND 16.0 PSID TO PREVENT OVER PRESSURIZATION OF THE CABIN AND IS CAPABLE OF FLOWING A MINIMUM OF 150 LB/HR AT 16 PSID. VALVE IS MOUNTED ON THE XO 576 BULKHEAD, WITH A SINGLE O-RING SEAL (REF FMEA 01-4-CS44-1).

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**- APPROVALS -**


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EDITORIALLY APPROVED	: BNA	: <u>J. Kimura 10-28-98</u>
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: 96-CIL-020_06-1C

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ATTACHMENT  
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FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE  
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SUBSYSTEM: ARS - ARPCS	REVISION#	7 01/16/91 R
LRU :RV, CABIN POSITIVE PRESSURE	} <i>VERIFY PART NAME</i>	CRITICALITY OF THIS FAILURE MODE:1R2
ITEM NAME: RV, CABIN POSITIVE PRESSURE		

FAILURE MODE:  
INABILITY TO RELIEVE

MISSION PHASE:  
LO LIFT-OFF  
OO ON-ORBIT  
DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:	102	COLUMBIA
	: 103	DISCOVERY
	: 104	ATLANTIS
	: 105	ENDEAVOUR

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

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS  
B) N/A  
C) PASS

PASS/FAIL RATIONALE:  
A)

B)  
SCREEN B IS N/A BY DEFINITION FOR STANDY REDUNDANCY OF RELIEF VALVES.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:  
LOSS OF REDUNDANCY - ONE RELIEF VALVE ASSEMBLY REMAINS TO RELIEVE EXCESSIVE CABIN PRESSURE.

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(B) INTERFACING SUBSYSTEM(S):  
NO EFFECT.

(C) MISSION:  
POSSIBLE EARLY MISSION TERMINATION - ONLY ONE VALVE ASSEMBLY CAN BE USED TO RELIEVE EXCESSIVE CABIN PRESSURE.

(D) CREW, VEHICLE, AND ELEMENT(S):  
CREW ACTION REQUIRED TO MONITOR PRESSURE.

- (E) FUNCTIONAL CRITICALITY EFFECTS:  
LOSS OF CABIN POSITIVE PRESSURE RELIEF CAPABILITY WILL RESULT IF EITHER THE ISOLATION VALVE OR THE POPPET VALVE (IN ONE ASSEMBLY) FAILS IN THE CLOSED POSITION AND THE REDUNDANT RELIEF VALVE ASSEMBLY IS ALSO FAILED IN THE CLOSED POSITION. POSSIBLE LOSS OF CREW/VEHICLE FROM OVERPRESSURIZATION.

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- DISPOSITION RATIONALE -  
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(A) DESIGN:  
THE VALVE BODY IS MADE OF 6061-T6 ALUMINUM, ANODIZED FOR CORROSION RESISTANCE. THE RELIEF VALVE IS A POPPET TYPE, PRESSURE COMPENSATED BY A BELLOWS, AND INCORPORATES AN ELECTRICALLY OPERATED CLOSING OVERRIDE. THE POPPET SEAL IS A PRECISION MOLDED SILICONE ELASTOMER WHICH REQUIRES A VERY LOW SEAT SQUEEZE FORCE WHILE MAINTAINING A LOW LEAKAGE RATE. SILICONE RUBBER IS AN ORGANOSILICONE OXIDE POLYMER WHICH IS CHARACTERIZED BY REMARKABLE TEMPERATURE STABILITY, CHEMICAL INERTNESS, WATER PROOFNESS, AND EXCELLENT DIELECTRIC PROPERTIES. A CAPTIVE DEBRIS SCREEN ON THE CABIN SIDE AND A FILTER SCREEN ON THE BULKHEAD SIDE OF THE VALVE PROVIDE PROTECTION FROM FOREIGN MATERIAL.

(B) TEST:  
ACCEPTANCE TEST - PER ATP 2655-5. PROOF PRESSURE 24.5 - 25.5 PSIG. INTERNAL AND EXTERNAL LEAKAGE TEST AT 15 +/- .15 PSIG, 15 SCCM MAX LEAKAGE. CRACKING PRESSURE 15.5 - 16.0 PSID. RESEAT PRESSURE 15.5 PSID MINIMUM. MINIMUM FLOW AT 16.0 PSID, 153 LB/HR.

QUALIFICATION TEST - PER QTP 2655-5. BURST PRESSURE 32 PSIG. DESIGN SHOCK - 20G 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. SINUSOIDAL VIBRATION - 5 - 35 HZ AT +/- 0.25 G PEAK IN THREE ORTHOGONAL AXES; DURATION CONTROLLED BY A ONE

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OCTAVE PER MINUTE SWEEP RATE. THERMAL VACUUM TEST WAS PERFORMED AT 1 PSIA MAX. TEMPERATURE WAS CYCLED BETWEEN -65 F AND +200 F AND LEAKAGE MEASURED; MAX LEAKAGE 15 SCCM. OPERATING LIFE - 200 RELIEF VALVE CRACK/RESEAT CYCLES. ATP TO VERIFY LEAKAGE IS PERFORMED AFTER SHOCK AND VIBRATION TESTING.

IN-VEHICLE TESTING - RELIEF VALVE CRACK TEST IS PERFORMED AT 15.5 - 16.0 PSID MAX, 150 LB/HR MINIMUM FLOW. FULL FLOW TEST IS PERFORMED AT 16.0 PSID MAX, 150 LB/HR MINIMUM FLOW.

OMRSD - RELIEF VALVE CRACK TEST IS PERFORMED BEFORE THE FIRST REFLIGHT OF EACH ORBITER AND AT INTERVALS OF FIVE FLIGHTS, AT 15.5 - 16.0 PSID. FULL FLOW TEST IS AT 16.0 PSID MAX, 150 LB/HR MINIMUM FLOW.

**(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 100 ML RINSE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

BELLEVILLE SPRING FORCES AND TORQUES ARE VERIFIED. DIMENSIONAL CHECKS ARE PERFORMED BY INSPECTION. MIPS FOR CONCENTRICITY AND PERPENDICULARITY. VISUAL INSPECTION USING 10X MAGNIFICATION ON SEAL RING IS VERIFIED BY INSPECTION. SAFETY WIRING IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

X-RAYS OF BRAZES AND WELDS ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES

HEAT TREAT AND PARTS PASSIVATION ARE VERIFIED BY INSPECTION. LUBRICANT APPLICATION ON SEAL RING VERIFIED BY INSPECTION. POTTING VISUALLY VERIFIED BY INSPECTION. SOLDERING 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.

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THE RELIEF VALVE HAS SUCCESSFULLY BEEN USED THROUGH THE SHUTTLE PROGRAM  
CONSIDERING THIS FAILURE MODE.

(E) OPERATIONAL USE:

~~TBS.~~ NONE

- APPROVALS -

RELIABILITY ENGINEERING: O. R. RISING *ORR* : *[Signature]*  
DESIGN ENGINEERING : K. KELLY *KK* : *[Signature]*  
QUALITY ENGINEERING : M. SAVALA *JRB* : *Michael for 030 2/9/91*  
NASA RELIABILITY : : *[Signature]*  
NASA SUBSYSTEM MANAGER : : *[Signature]*  
NASA QUALITY ASSURANCE : : *[Signature]*