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S050260E  
ATTACHMENT  
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FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: 06-1A-1122-X

SUBSYSTEM NAME: ARS - AIRLOCK

REVISION : 2 09/21/90

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	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	EQUALIZATION VALVE CARLETON TECHNOLOGIES	MC250-0004-0012 2763-0001-9

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PART DATA

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QUANTITY OF LIKE ITEMS: 2  
TWO ON OUTER HATCH

FUNCTION:  
EQUALIZATION VALVE, AIRLOCK (TUNNEL)/PAYLOAD BAY HATCH

PROVIDES FOR EQUALIZING PRESSURE ACROSS THE PAYLOAD BAY/AIRLOCK (TUNNEL) HATCH. EACH VALVE OPERATES INDEPENDENTLY WITH POSITIVE DETENTS AT TWO FLOW POSITIONS. VALVE CAN BE ACTUATED FROM EITHER SIDE OF HATCH.

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SUBSYSTEM: ARS - AIRLOCK  
LRU :EQUALIZATION VALVE  
ITEM NAME: EQUALIZATION VALVE

CRITICALITY OF THIS  
FAILURE MODE:1R2

FAILURE MODE:  
INABILITY TO CLOSE, INTERNAL LEAKAGE

MISSION PHASE:  
00 ON-ORBIT

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

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

■ 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 BECAUSE THE EQUALIZATION VALVE IS IN STANDBY AND THE CAP  
IS THE FIRST SEALING COMPONENT.  
C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:  
NO EFFECT.

(B) INTERFACING SUBSYSTEM(S):  
NO EFFECT - CAP PROVIDES REDUNDANT SEAL.

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(C) MISSION:  
NO EFFECT.

(D) CREW, VEHICLE, AND ELEMENT(S):  
NO EFFECT.

- (E) FUNCTIONAL CRITICALITY EFFECTS:  
SECOND ASSOCIATED FAILURE (LOSS OF EQUALIZATION VALVE CAP) CAN CAUSE LOSS OF AIRLOCK REPRESSURIZATION CAPABILITY AND LOSS OF EVA CREWMEN OR LOSS OF ABILITY TO PERFORM A CONTINGENCY EVA.

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- DISPOSITION RATIONALE -  
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- (A) DESIGN:  
THE BUTTERFLY VALVE CONSISTS OF A VALVE DISC WITH A SILICONE ELASTOMER VALVE SEAL PERMANENTLY MOLDED AND INTERLOCKED AROUND THE CIRCUMFERENCE OF THE VALVE DISC. THE VALVE BORE SEATING AREA IS TEFLON IMPREGNATED AND HARD ANODIZED TO PROVIDE MAXIMUM CORROSION RESISTANCE WITH A MINIMUM COEFFICIENT OF FRICTION. BUTTERFLY VALVE STEM THRUST BEARINGS ELIMINATE LONGITUDINAL RUNOUT, INSURING: THE VALVE STEM CENTERLINE RUNS THROUGH BORE CENTERLINE, UNIFORM VALVE SEATING FORCES AND HANDLE ACTUATION FORCES.
- (B) TEST:  
QUALIFICATION TEST FOR 100 MISSION LIFE: ACCELERATION OF 5 G FOR FIVE MINUTES PER AXIS. SINUSOIDAL VIBRATION - 5 TO 35 HZ AT +/- 0.25 G PEAK PER AXIS. RANDOM VIBRATION - 0.09 G\*\*2/HZ FOR 48 MIN/AXIS. DESIGN SHOCK- 20G PER AXIS. THERMAL VACUUM/THERMAL CYCLE - WITH VALVE CLOSED AND COVER ON, UNIT EXPOSED TO 120 TO 130 F AND VACUUM OF  $1 \times 10^{-6}$  TORR FOR 24 HOURS. LOW/HIGH TEMPERATURE CYCLE - HELD AT -40 TO -50 F FOR 3 HOURS AND AT +120 TO 130 F FOR 3 HOURS. OPERATING LIFE - OPERATED IN OFF/NORMAL/EMERGENCY POSITIONS WITH 15 PSIG APPLIED FOR 800 CYCLES. LEAKAGE MONITORED DURING OR AFTER THESE TESTS LIMITED TO 5 SCCM MAX. BURST PRESSURE TEST AT 30 PSIG (TWICE OPERATING PRESSURE) FOR 5 MINUTES.

ACCEPTANCE TEST - PROOF PRESSURE 25 PSIG GN2, WITH VALVE OPEN AND CLOSED. LEAK CHECK AT 15 PSIG, 5 SCCM MAX - VALVE OPEN AND CLOSED AND REVERSE LEAKAGE.

IN-VEHICLE TESTING - 3.2 PSID LEAK TEST.

QMRSD - AIRLOCK VALVES OPENING AND CLOSING TORQUES VERIFIED EVERY 10 FLIGHTS. OPERATIONAL CHECKOUT OF VALVES EVERY FIVE FLIGHTS. GROSS LEAKAGE TEST AT 2 PSID BEFORE EACH FLIGHT VERIFIES NO GROSS LEAKAGE THROUGH BOTH THE VALVE AND CAP SIMULTANEOUSLY.

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## ■ (C) INSPECTION:

## RECEIVING INSPECTION

MATERIALS VERIFIED AT RECEIVING INSPECTION. VERIFIES CERTIFICATION THAT ALUMINUM HOUSING CASTINGS ARE HYDROSTATIC PROOF PRESSURE TESTED AT 32 PSID BY SUBTIER VENDOR.

## CONTAMINATION CONTROL

CORROSION PROTECTION PROVISIONS AND CONTAMINATION CONTROL PLAN VERIFIED BY INSPECTION. CLEANLINESS LEVELS OF 200A AND 100 ML RINSE TESTS VERIFIED.

## ASSEMBLY/INSTALLATION

MANUFACTURING PROCESSES, INSTALLATION AND ASSEMBLY VERIFIED BY INSPECTION. TORQUES VERIFIED BY INSPECTION. DIMENSIONAL CHECKS PERFORMED BY INSPECTION. INSPECTION PERFORMS MIPS FOR CONCENTRICITY AND PERPENDICULARITY. O-RINGS VERIFIED BY INSPECTION.

## NONDESTRUCTIVE EVALUATION

ALUMINUM HOUSING CASTINGS ARE X-RAYED AND DYE PENETRANT INSPECTED TO DETECT CRACKS, VERIFIED BY INSPECTION.

## CRITICAL PROCESSES

PASSIVATED PARTS AND HEAT TREATMENT VERIFIED BY INSPECTION. MECHANICAL SOLDERING OF DEBRIS SCREEN VERIFIED BY INSPECTION. ANODIZATION OF ALUMINUM PARTS VERIFIED BY INSPECTION.

## TESTING

ATP VERIFIED BY INSPECTION.

## HANDLING/PACKAGING

PARTS PROTECTION VERIFIED BY INSPECTION.

## ■ (D) FAILURE HISTORY:

(AC2285) DURING LEAK CHECK AFTER INSTALLATION OF HATCH "B" INTO VEHICLE, SUPER KOROPON PAINT CHIPS IN THE VALVE CAUSED INTERNAL LEAKAGE. VALVE WAS REMOVED FROM VEHICLE AND REPLACED. CONTAMINATED VALVE WAS RETURNED TO SUPPLIER, CLEANED AND RETURNED TO STOCK.

## ■ (E) OPERATIONAL USE:

NO CREW ACTION REQUIRED IF CAP IS INSTALLED. IF CAP IS NOT INSTALLED, CREW SHOULD INSTALL CAP AND USE REDUNDANT EQUALIZATION VALVE.

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- APPROVALS -

RELIABILITY ENGINEERING:	D. R. RISING	DBK	≡	Libson 1/27/90
DESIGN ENGINEERING	: K. KELLY	KA	:	<u>                    </u>
QUALITY ENGINEERING	: M. SAVALA		:	<u>                    </u>
NASA RELIABILITY	:		:	1/22 : <u>                    </u>
NASA SUBSYSTEM MANAGER	:		:	9 PA : <u>                    </u>
NASA QUALITY ASSURANCE	:		:	<u>                    </u>