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PRINT DATE: 01/12/94

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE  
NUMBER: 06-1B-0760-X**

**SUBSYSTEM NAME: ARS - COOLING**

**REVISION: 9 01/12/94**

	<b>PART NAME VENDOR NAME</b>	<b>PART NUMBER VENDOR NUMBER</b>
LRU	: REGENERABLE CO2 REMOVAL SYSTEM	MC623-0016
SRU	: VALVE, SOLENOID	SV806914

**PART DATA**

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
PRESSURE EQUALIZATION VALVE**

**QUANTITY OF LIKE ITEMS: 6**

**FUNCTION:**

- 1) VALVE 1 OPENS TO EXPOSE BED A TO VACUUM. THIS EQUALIZES THE PRESSURE ACROSS BOTH OUTLET VACUUM PORTS, ENABLING THE VACUUM CYCLE VALVE ACTUATOR TO OPEN THESE PORTS. VALVE 4 PERFORMS SAME FUNCTION FOR BED B VACUUM PORTS PRESSURE EQUALIZATION.
- 2) VALVE 2 OPENS TO EXPOSE BED A TO THE ULLAGE SAVE COMPRESSOR INLET, THUS AIR IS RECOVERED TO CABIN AND THE BED PRESSURE IS BROUGHT DOWN FROM AMBIENT TO 3.0 PSIA. VALVE 5 PERFORMS SAME FUNCTION FOR BED B ULLAGE SAVE. VALVES 2 AND 5 BOTH OPEN TO PERFORM BED EQUALIZATION. A FINAL NOMINAL PRESSURE OF 1.5 PSIA IN EACH BED RESULTS.
- 3) VALVE 3 OPENS TO REPRESSURIZE BED A TO CABIN PRESSURE. THIS EQUALIZES THE PRESSURE ACROSS BOTH THE INLET AND OUTLET PROCESS AIR PORTS OF THE VACUUM CYCLE VALVES, ENABLING THE VACUUM CYCLE VALVE ACTUATOR TO OPEN THESE PORTS. VALVE 6 PERFORMS THE SAME FUNCTION FOR BED B PRESSURE EQUALIZATION.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE  
NUMBER: 06-18-0780-02

SUBSYSTEM: ARS - COOLING  
LRU :REGENERABLE CO2 REMOVAL SYSTEM  
ITEM NAME: VALVE, SOLENOID

REVISION# 7 06/26/92 R

CRITICALITY OF THIS  
FAILURE MODE:2/2

- FAILURE MODE:  
FAILS CLOSED, RESTRICTED FLOW

MISSION PHASE:  
00 ON-ORBIT

- VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA  
: 105 ENDEAVOUR

- CAUSE:  
MECHANICAL SHOCK, VIBRATION, CORROSION, CONTAMINATION, PHYSICAL BINDING/  
JAMMING, ELECTRICAL OPEN, CONTROLLER FAILURE.

- CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:

- A)
- B)
- C)

- MASTER MEAS. LIST NUMBERS: V61P2901A  
: V61P2902A  
: V61P2911A  
: V61P2912A  
: V61P2922A

- FAILURE EFFECTS -

- (A) SUBSYSTEM:  
1) LOSS OF USE OF THE REGENERABLE CO2 REMOVAL SYSTEM. VALVE 1 OR 4  
FAILING CLOSED WOULD CAUSE A 1.5 - 2.0 PSI DELTA ACROSS THE VACUUM  
POPPETS PRIOR TO EXPOSURE TO VACUUM, THUS, UNABLE TO OPEN THE VACUUM

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NUMBER: 06-1B-0780-02

PORTS. THE CONTROLLER WILL DETECT THE FAULT AND SHUT DOWN THE SYSTEM.

2) LOSS OF USE OF THE RCRS. VALVE 2 OR 5 FAILURE CAUSES INABILITY TO PERFORM ULLAGE SAVE OR TO EQUALIZE BEDS. THE CONTROLLER WILL DETECT THE ANOMALY AND SHUT DOWN THE SYSTEM.

3) LOSS OF USE OF THE RCRS. VALVE 3 OR 6 FAILURE CAUSES INABILITY TO EQUALIZE PRESSURES ACROSS THE VACUUM CYCLE VALVES; DELTA PRESSURE IS IN THE RANGE OF 14 PSID, THUS, UNABLE TO OPEN THE PROCESS AIR PORTS. THE CONTROLLER WILL DETECT THE FAULT AND SHUT DOWN THE SYSTEM.

■ (B) INTERFACING SUBSYSTEM(S):

- 1) INCREASED PPCO2 IN CABIN.
- 2) INCREASED PPCO2 IN CABIN.
- 3) INCREASED PPCO2 IN CABIN.

■ (C) MISSION:

- 1) POTENTIAL EARLY MISSION TERMINATION.
- 2) POTENTIAL EARLY MISSION TERMINATION.
- 3) POTENTIAL EARLY MISSION TERMINATION.

■ (D) CREW, VEHICLE, AND ELEMENT(S):

NO EFFECT.

■ (E) FUNCTIONAL CRITICALITY EFFECTS:

LOSS OF USE OF THE RCRS, BACKUP LIQH CANISTER MUST BE USED FOR CO2 REMOVAL UNTIL LANDING. THE LIQH SUPPLY IS ADEQUATE TO ACCOMMODATE 3 DAY MISSION. LOSS OF ALL BACKUPS MAY RESULT IN LOSS OF CREW/VEHICLE. A 1R3 PPP CRITICALITY SCENARIO RESULTS.

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- DISPOSITION RATIONALE -  
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■ (A) DESIGN:

PEV VALVE IS A DUAL COIL SOLENOID-OPERATED, POPPET FLOW VALVE, MAGNETICALLY LATCHED OPEN AND SPRING LOADED CLOSED. THE VALVE IS NON-JAMMING IN BOTH THE OPEN AND CLOSED POSITION. THE VALVE BODY IS 430 STAINLESS STEEL, VESPEL SP-21 POPPET SEAT ARRANGEMENT WITH A FLUORIO-SILICONE SEAT.

■ (B) TEST:

QUALIFICATION TEST FOR 100 MISSIONS:

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QUALIFICATION TEST IS PERFORMED WHEN THE PEV IS INSTALLED AT THE RCRS PACKAGE LEVEL. RANDOM VIBRATION INCREASING AT PLUS 6 db/oct FROM 20 TO 45 HZ; CONSTANT AT 0.003 g<sup>2</sup>/HZ FROM 45 TO 1000 HZ; DECREASING AT MINUS 6 db/oct FROM 1000 TO 2000 HZ FOR 48 MINUTES PER AXIS IN THREE ORTHOGONAL AXES.

ACCEPTANCE TEST:

PROOF PRESSURE- APPLIED INTERNAL PRESSURE OF 27 PSID, WITHOUT PERMANENT DEFORMATION OR DEGRADING OF PERFORMANCE.

LEAKAGE TEST- INTERNAL LEAKAGE ACROSS THE POPPET AND SEAT WITH THE PEV CLOSED IS NOT TO EXCEED .25 SCCM OF AIR AT 70 DEGREES F, WITH 14.7 PSID APPLIED; EXTERNAL LEAKAGE- NO AIR LEAKAGE WHEN 22.5 PSID IS APPLIED TO THE INTERNAL PRESSURE. BURST PRESSURE OF 36 PSID APPLIED TO THE INTERNAL PRESSURE (WITHOUT RUPTURE).

THE VALVE IS SUBJECT TO PULL-IN/DROP-OUT TEST FOR BOTH THE OPENING AND CLOSING COILS (PRIMARY AND REDUNDANT).

INSULATION RESISTANCE TEST IS CHECKED FOR BOTH COIL-TO-CASE AND COIL-TO-COIL. THE VALVE IS TESTED FOR DIELECTRIC STRENGTH AND SHALL WITHSTAND 1250 VOLTS RMS INPUT VOLTAGE FOR THE COIL-TO-CASE TEST.

■ (C) INSPECTION:

RECEIVING INSPECTION

INCOMING PART/MATERIAL IDENTIFICATION AND CERTIFICATION VERIFIED BY INSPECTION. KITTING, SOLDER AND ATP VERIFIED AT VENDOR BY H. S. SOURCE INSPECTION. DIMENSIONAL CHECKS PERFORMED AT VENDOR BY H. S. SOURCE INSPECTION.

CONTAMINATION CONTROL

CONTAMINATION CONTROL PROCESSES AND CLEAN AREAS VERIFIED BY INSPECTION. CLEANLINESS OF VALVE VERIFIED TO PRECISION CLEAN REQUIREMENTS AT RCRS LEVEL OF ASSEMBLY.

ASSEMBLY/INSTALLATION

INSTALLATION OPERATIONS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

TORQUE OPERATIONS VERIFIED TO H. S. REQUIREMENTS.

TESTING

SOLENOID PULL IN/DROP OUT TESTING PERFORMED. LEAK, PROOF, PRESSURE DROP, FLOW AND INTERNAL LEAKAGE TESTING PERFORMED AT VENDOR VERIFIED BY H. S. SOURCE INSPECTION. ATP TESTING AT THE RCRS PACKAGE LEVEL VERIFIED TO BE WITHIN LIMITS BY INSPECTION. VIBRATION TESTING OF ORIGINAL DEVELOPMENT TEST UNIT AS A DETAIL OF RCRS PACKAGE VERIFIED BY INSPECTION. INSULATION RESISTANCE TESTING VERIFIED BY H. S. SOURCE INSPECTION.

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HANDLING/PACKAGING  
HANDLING AND PART PROTECTION PER H. S. REQUIREMENTS.

- (D) FAILURE HISTORY:  
NO FAILURE HISTORY
- (E) OPERATIONAL USE:  
SHUTDOWN THE RCRS AND INSTALL NEW CANISTERS FOR CO2 REMOVAL. LIQH  
SUPPLY IS ADEQUATE FOR 3 DAYS.

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- APPROVALS -  
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RELIABILITY MANAGER : T. J. EAVENSON  
 DESIGN ENGINEERING : P. J. CHEN  
 QUALITY ENGINEERING : E. OCHOA  
 NASA RELIABILITY :  
 NASA QUALITY ASSURANCE :

NASA SSM :

*V. L. Foster for 6/20/92*  
~~PS Chen~~  
~~John L. Foster for T.J. Eavenson 6/20/92~~  
~~J. B. ... 7/8/92~~  
~~... 8-21-92~~  
~~...~~  
~~... 9/9/92~~