

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: 06-1B-0830-X

SUBSYSTEM NAME: ARS - COOLING

REVISION : 7 06/26/92

| | PART NAME VENDOR NAME | PART NUMBER VENDOR NUMBER |
|---------|--------------------------------|------------------------------|
| ■ LRU : | REGENERABLE CO2 REMOVAL SYSTEM | MC623-0016 |
| ■ SRU : | VALVE, MOTORIZED | SV806920 |

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
VACUUM CYCLE VALVE (VCV)

■ QUANTITY OF LIKE ITEMS: 4

■ FUNCTION:

THESE VALVES DIRECT THE AIR FLOW INTO THE SORBENT BEDS DURING THE ABSORPTION CYCLE OR EXPOSE THE BED TO THE VACUUM CYCLE DURING BED REGENERATION. THE 4 VACUUM CYCLE VALVES ARE CONNECTED TOGETHER BY TWO INDEPENDENT LINKAGE ASSEMBLIES. THE AIR POPPET OF BED "A" IS CROSS-TIED TO THE VACUUM POPPET OF BED "B" AND VICE-VERSA. EACH LINKAGE SET IS DRIVEN BY AN ACTUATOR WHICH SYNCHRONOUSLY SWINGS THE POPPETS.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: 06-1B-0830-01

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

REVISION# 7 06/26/92 R

CRITICALITY OF THIS
FAILURE MODE:2/2

■ FAILURE MODE:
FAILS OPEN, INTERNAL LEAKAGE

MISSION PHASE:
00 ON-ORBIT

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

■ CAUSE:
MECHANICAL SHOCK, VIBRATION, CORROSION, CONTAMINATION, PHYSICAL BINDING/
JAMMING, SEAL DEFECT, BROKEN TORSION SPRING.

■ CRITICALITY I/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

- FAILURE EFFECTS -

■ (A) SUBSYSTEM:
THE CONTROLLER WILL DETECT THE LEAK THROUGH THE BED PRESSURE SENSOR AND
SHUT DOWN THE RCRS. LOSS OF USE OF THE RCRS.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: 06-1B-0830-01**

- (B) INTERFACING SUBSYSTEM(S):
INCREASED PPCO2 IN CABIN.
- (C) MISSION:
POSSIBLE EARLY MISSION TERMINATION.
- (D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT
- (E) FUNCTIONAL CRITICALITY EFFECTS:
 - 1) LOSS OF THE USE OF THE RCRS. THE LIQH SUPPLY IS ADEQUATE TO ACCOMMODATE 3 DAY MISSION (MINIMUM). LOSS OF ALL THESE BACKUPS MAY RESULT IN LOSS OF CREW/VEHICLE. A 1R3 PPP CRIT SCENARIO RESULTS.
 - 2) VACUUM PORT VALVE PLUS TWO ADDITIONAL FAILURES (CANISTER LEAKAGE AND VACUUM VENT ISOLATION VALVE FAILS OPEN) WILL RESULT IN LOSS OF CABIN ATMOSPHERE (CRIT 1R3 PPP).
 - 3) AIR PROCESS PORT AND VACUUM PORT VALVES ON THE SAME BED FAILED OPEN AND VACUUM VENT ISOLATION VALVE FAILS OPEN WILL RESULT IN CONNECTION OF CABIN ATMOSPHERE TO VACUUM (CRIT 1R3PPP).

- DISPOSITION RATIONALE -

- (A) DESIGN:
THE RCRS VACUUM CYCLE VALVE DESIGN IS AN ALUMINUM HOUSING VALVE CONTAINING TWO POPPET VALVES, AIR POPPET AND A VACUUM POPPET. THE POPPET SHAFT INCORPORATES A TORSION SPRING DESIGN WHICH PERMITS IMPROPER SHAFT ROTATION AND/OR WHEN THE POPPET DELTA PRESSURE IS GREATER THAN 3.4 PSID, WITHOUT POPPET BEING LIFTED OFF, PREVENTS LINKAGE/VALVE STRUCTURE DAMAGE AND AIR LEAKAGE TO VACUUM. POPPET ARM SHAFT RIDES ON A RULON BUSHING AND IS DRIVEN BY AN ACTUATOR THROUGH HARD LINKAGES. THE POPPET SEAT IS A MOLDED SILICONE RUBBER SEAL. CORROSION RESISTANT MATERIAL USED FOR SPRING FABRICATION.
 - (B) TEST:
QUALIFICATION TEST FOR 100 MISSION LIFE:
VCV IS TESTED WHEN INSTALLED AT THE RCRS ASSEMBLY LEVEL. RANDOM VIBRATION INCREASING AT PLUS 6 db/oct FROM 20 TO 45 HZ; CONSTANT AT 0.003 g2/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. VALVE IS TESTED FOR 50,000 CYCLES WITH NO EVIDENCE OF FAILURE OR DAMAGE TO VERIFY DESIGN LIFE REQUIREMENTS.
- ACCEPTANCE TEST:

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE

NUMBER: 06-18-0030-01

PROOF PRESSURE TEST AT 1.5 TIMES THE OPERATING PRESSURE (18PSIA) DIFFERENTIAL AND HOLD FOR 5 MINUTES WITH NO STRUCTURE DAMAGE OR PERMINENT DEFORMATION. LEAKAGE TEST NOT TO EXCEED 9 SCCM AT 14.7 PSID TO VERIFY LEAKS INTEGRITY.

OMRSD:

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD AT SYSTEM LEVEL.

■ (C) INSPECTION:

RECEIVING INSPECTION

INCOMING MATERIAL IDENTIFICATION AND CERTIFICATION VERIFIED BY INSPECTION. 100% VISUAL/DIMENSIONAL INSPECTION OF SEALS, SPRINGS AND POPPETS PERFORMED AT VENDOR BY H. S. SOURCE INSPECTION.

CONTAMINATION CONTROL

CONTAMINATION CONTROL PROCESSES AND CLEAN AREAS VERIFIED BY INSPECTION. CLEANLINESS VERIFIED TO REQUIREMENTS.

ASSEMBLY/INSTALLATION

ASSEMBLY/INSTALLATION REQUIREMENTS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

ANODIZE PROCESSING VERIFIED BY INSPECTION. TORQUE OPERATIONS VERIFIED TO H. S. REQUIREMENTS.

TESTING

VALVE ACTUATION TEST PERFORMED TO VERIFY FUNCTION. VALVE FUNCTION TESTED AS A DETAIL OF RCRS ASSEMBLY DURING ATP. ATP TESTING VERIFIED BY INSPECTION. VIBRATION TEST OF ORIGINAL DEVELOPMENT TEST UNIT AS A DETAIL OF RCRS ASSEMBLY VERIFIED BY INSPECTION DURING QUALIFICATION. PROOF PRESSURE AND LEAK TEST VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING AND PART PROTECTION MAINTAINED PER H. S. REQUIREMENTS.

■ (D) FAILURE HISTORY:

NO FAILURE HISTORY.

■ (E) OPERATIONAL USE:

SHUT DOWN THE RCRS TO ISOLATE LEAKAGE, AND INSTALL NEW LIOH CANISTERS FOR CO2 REMOVAL. THE LIOH CANISTER SUPPLY IS ADEQUATE FOR 3 DAYS.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE

NUMBER: 06-1B-0830-01

- APPROVALS -

| | | | | |
|------------------------|---|----------------|---|--------------------------------|
| RELIABILITY MANAGER | : | T. J. EAVENSON | : | <i>K.L. Paster for 6/21/92</i> |
| DESIGN ENGINEERING | : | P. J. CHEN | : | <i>[Signature]</i> |
| QUALITY ENGINEERING | : | E. OCHOA | : | <i>[Signature]</i> |
| NASA RELIABILITY | : | | : | <i>[Signature]</i> |
| NASA SUBSYSTEM MANAGER | : | | : | <i>[Signature]</i> |
| NASA QUALITY ASSURANCE | : | | : | <i>[Signature]</i> |

John K.L. Paster for T.J. Eavenson 6/21/92
[Signature] 7/21/92
[Signature] 9/18/92
[Signature] 9/19/92
[Signature] 8-21-92
[Signature] 8/21/92