PRINT DATE: 08/27/93

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL HARDWARE**
**NUMBER: 06-1C-0126-X**

**SUBSYSTEM NAME:** ARS - ARPCS

**REVISION: 5 08/26/93**

| | | PART NAME<br>VENDOR NAME | PART NUMBER<br>VENDOR NUMBER |
|---|---|---|---|
| LRU | : | N2/O2 CONTROL PANEL<br>CARLETON TECHNOLOGIES | MC250-0002-1001<br>2720-0001 |
| SRU | : | VALVE, RELIEF & REG, O2 | 1-4-00-58-13 |

## PART DATA

**QUANTITY OF LIKE ITEMS:** 2
ONE PER LOOP
TWO PER SUBSYSTEM

**FUNCTION:**
PRESSURE REGULATOR,
OXYGEN SUPPLY, SINGLE STAGE

REGULATES OXYGEN PRESSURE EITHER FROM A 900 OR A 300 PSI SOURCE (WHEN THE HIGH PRESSURE OXYGEN TANK IS INSTALLED) TO 100 PSIG FOR PRESSURIZATION TO THE TWO-GAS CONTROL SYSTEM OR THE SPACELAB PAYLOAD WITH TOTAL FLOW RATES RANGING FROM 0 TO 75 POUNDS PER HOUR MINIMUM. THE REGULATOR IS INTEGRAL TO THE ON/OFF AND RELIEF VALVE ASSEMBLY.

PRINT DATE: 08/27/93

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE**
**NUMBER: 06-1C-0126-03**

**REVISION#**

**SUBSYSTEM NAME:** ARS - ARPCS
**LRU:** N2/O2 CONTROL PANEL
**ITEM NAME:** VALVE, RELIEF & REG, O2

**CRITICALITY OF THIS FAILURE MODE:** 1R2

**FAILURE MODE:**
EXTERNAL LEAKAGE

**MISSION PHASE:**

| | |
|---|---|
| PL | PRELAUNCH |
| LO | LIFT-OFF |
| OO | ON-ORBIT |
| DO | DE-ORBIT |
| LS | LANDING SAFING |

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

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

**CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO**

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**REDUNDANCY SCREEN**
A) PASS
B) PASS
C) PASS

**PASS/FAIL RATIONALE:**
A)

B)

C)

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**- FAILURE EFFECTS -**

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**(A) SUBSYSTEM:**
LEAKAGE OF OXYGEN INTO CABIN UNTIL REG INLET VALVE IS CLOSED.

**(B) INTERFACING SUBSYSTEM(S):**
INCREASED CABIN PPO2 UNTIL CORRECTING ACTION TAKES EFFECT. MAY VIOLATE FLAMMABILITY LIMIT.

**(C) MISSION:**
POSSIBLE LOSS OF MISSION; ONLY THE REG INLET VALVE REMAINS TO ISOLATE LEAKAGE IN ORDER TO PRECLUDE LOSS OF EMERGENCY SYSTEM (LES).

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE NUMBER: 06-1C-0126-03**

**(D) CREW, VEHICLE, AND ELEMENT(S):**
WORST CASE FIRE IN CABIN - EXCESSIVE O2 FEEDING FIRE WHERE LES IS USED.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**
GROSS LEAKAGE OF REGULATOR COMBINED WITH INLET VALVE INTERNAL LEAKAGE CAUSES LOSS OF LES SYSTEM AND POSSIBLE LOSS OF CREW/VEHICLE.

**-DISPOSITION RATIONALE-**

**(A) DESIGN:**
THE VALVE BODY IS MADE OF ALUMINUM ALLOY 6061. THE REGULATOR IS AN INLET PRESSURE COMPENSATED, SPRING-REFERENCED TYPE EMPLOYING A 17-7 PH CONDITION C CRES DIAPHRAGM AS A SENSING ELEMENT AND DYNAMIC SEAL. 17-7 PH IS PRECIPITATION HARDENED CORROSION RESISTANT STEEL WHICH HAS A HIGH STRENGTH TO WEIGHT RATIO. THE DIAPHRAGM SEALS WHICH ARE MADE OF SILASTIC 675 SILICONE RUBBER HAVE EXCELLENT RESISTANCE TO OXYGEN, OUTGASSING, AND FATIGUE. THEY ELIMINATE THE FRICTION AND WEAR ASSOCIATED WITH PISTON TYPE SEALS. THE HELICAL/BELLEVILLE SPRING COMBINATION WHICH IS MADE OF 17-7 PH CRES PROVIDES REGULATION AND ASSURES A CLOSE TOLERANCE OPERATION OVER A WIDE FLOW RANGE. THE POPPET WHICH IS ALSO MADE OF 17-7 PH CRES WORKS AGAINST A POLYIMIDE VESPEL SP- 1 SEAT WHICH ASSURES A LEAK FREE OPERATION. THE INLET AND OUTLET PORTS ARE FILTER PROTECTED TO 25 MICRONS.

**(B) TEST:**
ACCEPTANCE TEST - PROOF TEST AT 1875 +/- 25 PSIG FOR A MINIMUM OF 3 MINUTES. LEAK TESTED AT INLET PRESSURE 885 +/- 25 PSIG AND OUTLET PRESSURE 125 PSIG; 0.3 SCCM MAX LEAKAGE. INTERNAL LEAKAGE TEST PERFORMED AT THE SAME PRESSURE; 0.2 SCCM MAX LEAKAGE.

QUALIFICATION TEST - LIFE CYCLE TESTING - 1000 CYCLES AT 875 +/- 25 PSIG. BURST PRESSURE IS 2500 PSIG. SUBJECTED TO THE FOLLOWING AS PART OF THE EMERGENCY O2 CONTROL PANEL. DESIGN SHOCK - THE UNIT WAS SUBJECTED TO 3 SHOCKS OF A 20 G PEAK ACCELERATION PULSE APPROXIMATELY A SAWTOOTH AND HAVING A TOTAL DURATION OF 11 MILLISECONDS. THIS PULSE WAS APPLIED IN BOTH DIRECTIONS OF THE THREE PRINCIPLE AXES FOR A TOTAL OF 18 SHOCKS. RANDOM VIBRATION SPECTRUM ENVELOPE - 20 TO 150 HZ INCREASING AT 6 DB/OCTAVE TO 0.03 G**2/HZ AT 150 HZ. CONSTANT AT 0.03 G**2/HZ FROM 150 TO 1000 HZ, DECREASING AT 6 DB/OCTAVE FROM 1000 TO 2000 HZ FOR 48 MINUTES PER AXIS FOR THREE ORTHOGONAL AXES. ATP TO VERIFY LEAKAGE IS PERFORMED AFTER SHOCK AND VIBRATION TESTING.

IN-VEHICLE TESTING - OVERPRESSURE AND LEAK TESTED.

OMRSD - 900, 100 PSI O2 EMERGENCY BREATHING SYSTEM 1 & 2 LEAK CHECK IS PERFORMED AT INTERVAL OF FIVE FLIGHTS AT 900 - 950 PSIG, 70 SCCM MAX SYSTEM LEAKAGE. IN FLIGHT CHECKOUT DURING EACH MISSION VERIFIES NO GROSS EXTERNAL LEAKAGE.

**(C) INSPECTION:**
RECEIVING INSPECTION
RAW MATERIALS, INCLUDING CHEMICAL AND MECHANICAL REQUIREMENTS, ARE VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

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CONTAMINATION CONTROL
CLEANLINESS LEVEL 200A PER MA0110-301 AND 100 ML RINSE TESTS VERIFIED. SYSTEM GAS SAMPLES ANALYZED FOR CONTAMINATION.

ASSEMBLY/INSTALLATION
DIAMETER AND THREADS ON LOWER BELLOWS VERIFIED BY INSPECTION. VISUAL, DIMENSIONAL, BELLOWS RATES AND CHECK FOR BELLOWS DAMAGE PERFORMED BY INSPECTION. TORQUES, BELLEVILLE SPRING FORCES, SURFACE, AND SUB-SURFACE DEFECTS VERIFIED. 10X VISUAL INSPECTION ON SEAL RING VERIFIED. NICKEL FINISH ON BELLOWS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
RADIOGRAPHIC AND PENETRANT INSPECTION OF WELDS ARE VERIFIED, INCLUDING 20X MAGNIFICATION VISUAL EXAM.

CRITICAL PROCESSES
PARTS PASSIVATION AND HEAT TREATMENT VERIFIED. LUBRICANT ON SEAL RING VERIFIED BY INSPECTION. POTTING APPLICATION AND SOLDER CONNECTIONS ARE VERIFIED BY INSPECTION.

TESTING
ATP VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PARTS ARE PLACED IN CLEAN BAGS AND HEAT SEALED. PACKAGING FOR SHIPMENT VERIFIED BY INSPECTION.

**(D) FAILURE HISTORY:**
NO FAILURE HISTORY.

**(E) OPERATIONAL USE:**
LEAK ISOLATION IS ACCOMPLISHED BY CLOSING THE AFFECTED REGULATOR'S INLET VALVE. THIS RESULTS IN LOSS OF REDUNDANCY - AUTOMATIC CONTROL THROUGH ONE O2 SYSTEM IS LOST.

**- APPROVALS -**

EDITORIALLY APPROVED : RI
EDITORIALLY APPROVED : JSC
TECHNICAL APPROVAL : VIA CR