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PRINT DATE: 08/27/93

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE
NUMBER: 06-1C-0122-X

SUBSYSTEM NAME: ARS - ARPCS

REVISION: 8 08/26/93

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: EMERGENCY O2 CONTROL PANEL CARLETON TECHNOLOGIES	MC250-0002-0120 2735-0001
SRU	: VALVE, RELIEF & REG, EM O2	1-4-00-58-15

PART DATA

QUANTITY OF LIKE ITEMS: 2
ONE PER FLOW PATH
TWO PER PANEL

FUNCTION:
RELIEF VALVE, EMERGENCY O2 REGULATOR

PROVIDE OVERPRESSURE RELIEF CAPABILITY DOWN STREAM OF EMERGENCY OXYGEN REGULATOR. RELIEF PRESSURE IS 245 PSIG. THIS VALVE IS INTEGRAL TO THE ON/OFF VALVE AND THE REGULATOR.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE
NUMBER: 06-1C-0122-01**

REVISION# 8 08/26/93

SUBSYSTEM NAME: ARS - ARPOS
LRU: EMERGENCY O2 CONTROL PANEL
ITEM NAME: VALVE, RELIEF & REG, EM O2

CRITICALITY OF THIS
FAILURE MODE: 1R2

FAILURE MODE:
OPEN, INCLUDING INTERNAL OR 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

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:
A)
B)
C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF OXYGEN UNTIL CORRECTING ACTION (C/A) IS IMPLEMENTED.

(B) INTERFACING SUBSYSTEM(S):
INCREASED PPO2 IN CABIN UNTIL C/A TAKES EFFECT.

(C) MISSION:
POSSIBLE EARLY MISSION TERMINATION.

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

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE
NUMBER: 06-1C-0122-01****(E) FUNCTIONAL CRITICALITY EFFECTS:**

SUBSEQUENT FAILURE OF REDUNDANT SYSTEM RESULTS IN LOSS OF OXYGEN SUPPLY TO LES BREATHING STATIONS. LOSS OF THIS EMERGENCY SYSTEM MAY RESULT IN 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. RELIEF VALVE OPERATIONAL TEST AT A CRACKING PRESSURE OF 245 PSIG MAX AND A RESEAT PRESSURE OF 215 PSIG MINIMUM.

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 (1070 - 1255 PSIG UPSTREAM AND 220 - 230 PSIG DOWNSTREAM) TESTED.

OMRSD - 900, 100 PSI O2 EMERGENCY BREATHING SYSTEM 1 & 2 LEAK CHECK IS PERFORMED PRIOR TO THE FIRST REFLIGHT OF EACH ORBITER AND EVERY FIVE FLIGHTS AT 900-950 PSIG INLET PRESSURE, 70 SCCM MAX SYSTEM LEAKAGE. RELIEF VALVE RESEAT PRESSURE OF 205 PSIG MIN AND RESEAT LEAKAGE OF 10 SCCM MAX IS VERIFIED (SAME EFFECTIVITY). INFLIGHT CHECKOUT DURING EACH MISSION VERIFIES NO GROSS EXTERNAL LEAKAGE.

(C) INSPECTION:

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RECEIVING INSPECTION
RAW MATERIAL 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 MAO110-301 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
VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
BRAZING, WELDING, X-RAYS AND PENETRANT INSPECTIONS ARE VERIFIED BY
INSPECTION.

CRITICAL PROCESSES
HEAT TREAT AND PARTS PASSIVATION AND ANODIZING 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 BY
INSPECTION.

(D) FAILURE HISTORY:
NO FAILURE HISTORY APPLICABLE TO OPEN, INTERNAL/EXTERNAL LEAKAGE FAILURE
MODE. THE RELIEF VALVE HAS SUCCESSFULLY BEEN USED THROUGH THE SHUTTLE
PROGRAM CONSIDERING THIS FAILURE MODE.

(E) OPERATIONAL USE:
CLOSE ASSOCIATED REGULATOR INLET TOGGLE VALVE TO ISOLATE LEAKING RELIEF
VALVE.

- APPROVALS -

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

[Handwritten Signature]
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:5502604