FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL HARDWARE
NUMBER: 06-1C-0120-X

SUBSYSTEM NAME: ARS - ARPCS

REVISION: 4 - 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:
SHUTOFF VALVE - EMERGENCY O2 PANEL REG INLET

PROVIDES MANUAL FLOW CONTROL (ON-OFF) AT THE INLET OF THE EMERGENCY OXYGEN CONTROL REGULATOR. THIS VALVE IS INTEGRAL TO THE REGULATOR/RELIEF VALVE.

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 06-1CI-0120-02

REVISION# 2 01/09/90

SUBSYSTEM: ARS - ARPCS
LRU :EMERGENCY O2 CONTROL PANEL CRITICALITY OF THIS
ITEM NAME: VALVE, RELIEF & REG, EM O2 FAILURE MODE:1R2

FAILURE MODE:
OPEN, INTERNAL 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) N/A
C) PASS

PASS/FAIL RATIONALE:
A)

B)
SCREEN B IS N/A BECAUSE BOTH VALVES ARE OPEN AT LAUNCH; EACH VALVE IS IN STANDBY TO BE CLOSED FOR LEAK ISOLATION.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NO EFFECT - VALVE IS NORMALLY OPEN.

(B) INTERFACING SUBSYSTEM(S):
SAME AS A.

(C) MISSION:
SAME AS A.

(D) CREW, VEHICLE, AND ELEMENT(S):
SAME AS A.

(E) FUNCTIONAL CRITICALITY EFFECTS:
A SUBSEQUENT FAILURE WHICH REQUIRED SHUTTING OFF THIS FLOW PATH WOULD REQUIRE UP STREAM SHUT OFF, DEACTIVATING BOTH OXYGEN FLOW PATHS TO THE LES BREATHING STATIONS.

- DISPOSITION RATIONALE -

(A) DESIGN:
VALVE BODY IS MADE OF 6061-T6 ALUMINUM ANODIZED FOR CORROSION RESISTANCE. POSITIVE OPEN/CLOSED OPERATION. BELLEVILLE SPRING LOADED TOGGLE DETENT ASSURES FULL OPEN OR CLOSED VALVE POSITION. INLET/OUTLET PORTS ARE FILTER PROTECTED TO 25 MICRONS. POPPET IS PRESSURE COMPENSATED THROUGH THE USE OF SILASTIC 675 SILICONE RUBBER DYNAMIC SEALS AT EACH END OF THE POPPET. SILASTIC 675 SILICONE RUBBER HAS GOOD RESISTANCE TO ENVIRONMENTAL EXPOSURE, FLEXING AND FATIGUE. IT ALSO HAS LOW FLAMMABILITY AND OUTGASSING. THE OZONE RESISTANCE OF SILICONE RUBBER IS EXCELLENT. THE 17-7 PH COLD DRAWN TO CONDITION C CRES POPPET WORKS AGAINST THE VESPEL-SP-1 SEAT WHICH IS UTILIZED FOR OXYGEN COMPATIBILITY AND LEAK-FREE OPERATION. 17-4 PH IS PRECIPITATION HARDENED CORROSION RESISTANT STEEL WHICH HAS A HIGH STRENGTH TO WEIGHT RATIO. THE MOST PROBABLE LEAK (TWO CUT O-RINGS WORST CASE) IS ESTIMATED AT 100 SCCM (0.0175 LB/HR).

(B) TEST:
ACCEPTANCE TEST - PROOF PRESSURE 1885 PSIG, LEAK TESTED FOR 1.0 SCCM MAX LEAKAGE AT 900 PSIG.

QUALIFICATION TEST - LIFE CYCLE TESTING - 1000 CYCLES AT 875 PSIG. BURST PRESSURE IS 2500 PSIG. SUBJECTED TO THE FOLLOWING AS PART OF THE EMERGENCY O2 CONTROL PANEL. DESIGN SHOCK - 20G TERMINAL SAWTOOTH PULSE OF 11 MS DURATION IN EACH DIRECTION OF THREE ORTHOGONAL AXES. 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 - INTERNAL LEAK TEST IS PERFORMED AT 925 - 950 PSIG, 10 SCCM MAX LEAKAGE.

OMRSD - EMERGENCY BREATHING SYSTEM REG CHECKOUT, PERFORMED BEFORE THE FIRST REFLIGHT OF EACH ORBITER AND EVERY FIVE FLIGHTS, VERIFIES INTERNAL LEAKAGE IS LESS THAN 10 SCCM AT 900 - 950 PSIG INLET PRESSURE. LES MANUAL VALVES CHECKOUT (SAME EFFECTIVITY) VERIFIES VALVE OPERATION.

(C) INSPECTION:
RECEIVING INSPECTION
RAW MATERIAL VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL
CLEANLINESS LEVEL 200A PER MA0110-301 AND 100 ML RINSE TESTS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
TORQUES VERIFIED BY INSPECTION. SPRING FORCE VERIFIED BY INSPECTION. DIMENSIONAL CHECKS PERFORMED BY INSPECTION. MIPS FOR CONCENTRICITY AND PERPENDICULARITY. 10X VISUAL INSPECTION ON SEAL RING VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
INSPECTION OF WELDS BY X-RAY, PENETRANT INSPECTION AND 20X VISUAL EXAMINATION VERIFIED BY INSPECTION.

CRITICAL PROCESSES
PARTS PASSIVATION AND ANODIZING VERIFIED BY INSPECTION. HEAT TREATMENT VERIFIED BY INSPECTION. SOLDER CONNECTIONS VERIFIED BY INSPECTION TO BE PER NHB53CC.4(3A). POTTING VISUALLY VERIFIED BY INSPECTION. APPLICATION OF LUBRICANT ON SEAL RING VERIFIED BY INSPECTION. TIG WELD SCHEDULE VERIFIED BY INSPECTION. CHEM FILMED PROCESSING VERIFIED BY INSPECTION.

TESTING
ATP VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING, PACKAGING, STORAGE AND SHIPPING PROCEDURES ARE VERIFIED.

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

(E) OPERATIONAL USE:
TBS.

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 06-1CI-0120-02

- APPROVALS -

RELIABILITY ENGINEERING	D. R. RISING DRR	
DESIGN ENGINEERING	K. KELLY RKL	for D.L. STAUDENMAIER
QUALITY ENGINEERING	M. SAVALA MS	D.J. Buttner 5/4/90
NASA RELIABILITY	TD	W.E. Steinlinger 5/10/90
NASA SUBSYSTEM MANAGER		Dennis M. Bory 5/11/90
NASA QUALITY ASSURANCE		5/3/90