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PRINT DATE: 01/12/84

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE
NUMBER: 06-1C-0114-X**

SUBSYSTEM NAME: ARS - ARPCS

REVISION: 5 01/12/84

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: N2/O2 CONTROL PANEL CARLETON TECHNOLOGIES	MC250-0002-1001 2720-0001
SRU	: VALVE, SELECTOR, OXYGEN	1-4-00-51-43

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

QUANTITY OF LIKE ITEMS: 1

FUNCTION:

MANUAL ISOLATION VALVE - EMERGENCY OXYGEN (1.88) SELECTOR VALVE

PROVIDES THE CAPABILITY TO CONNECT OR ISOLATE THE AUXILIARY OXYGEN AND THE PRSD CRYO OXYGEN DISTRIBUTION SYSTEMS. WHEN THE AUXILIARY OXYGEN STORAGE TANK IS NOT INSTALLED THE VALVE SERVES ONLY TO ISOLATE THE INACTIVE AUXILIARY OXYGEN SYSTEM. THE LISTED FAILURE EFFECTS ARE FOR THE CASE WHEN THE AUX O2 TANK IS NOT INSTALLED. THE FAILURE EFFECTS FOR THE CASE OF THE TANK BEING INSTALLED WILL BE ADDRESSED IN THE MISSION KIT FMEA ON A MISSION BY MISSION BASIS.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

NUMBER: 06-10E-0114-03

REVISION# 2 01/09/90

SUBSYSTEM: ARS - ARPCS
 LRU :N2/O2 CONTRGL PANEL
 ITEM NAME: VALVE, SELECTOR, OXYGEN

CRITICALITY OF THIS
 FAILURE MODE:1/1

■ FAILURE MODE:

GROSS EXTERNAL LEAKAGE (1.19 VALVE SIDE OF 1.88 VALVE POPPET AS WORST CASE) AUX. O2 TANK NOT INSTALLED

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, CORROSION, CONTAMINATION, MATERIAL DEFECT,
 SEAL MATERIAL DEGRADATION

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)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

UNCONTROLLED O2 FLOW INTO CABIN.

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(B) INTERFACING SUBSYSTEM(S):

POSSIBLE HIGH PPO2 UNTIL CORRECTING ACTION (C/A) TAKES EFFECT.
POSSIBLE FLAMMABILITY LIMIT VIOLATION.

(C) MISSION:

ABORT DECISION. LES/AIRLOCK O2 SUPPORT HAS BEEN LOST IF LEAKAGE IS SIGNIFICANT. CABIN O2 MAKE-UP CAPABILITY IS STILL AVAILABLE.

(D) CREW, VEHICLE, AND ELEMENT(S):

GROSS EXTERNAL LEAKAGE RESULTS IN INADEQUATE O2 SUPPLY TO LES STATIONS. THE LOSS OF LES SUPPORT CAPABILITY MAY RESULT IN LOSS OF CREW IF LEAK RATE PROHIBITS LES SYSTEM PRESSURIZATION AND LES ARE REQUIRED. NOTE - IN AN 8.0 PSIA HOLE IN CABIN CONTINGENCY MODE, AN EXTERNAL LEAK ALLOWING FLOW INTO THE CABIN MAY NOT BE CATASTROPHIC SINCE THERE IS A POSSIBILITY OF SAFELY BREATHING THE CABIN AIR, INTO WHICH THE O2 IS LEAKING, BY RAISING LES VISORS. THE WORST CASE FAILURE WOULD BE IN THE CASE OF A CONTAMINATED CABIN ATMOSPHERE, WHEN LEAKAGE PREVENTS ADEQUATE FLOW TO LES STATIONS AND CABIN AIR MAY NOT BE SAFE FOR BREATHING.

(E) FUNCTIONAL CRITICALITY EFFECTS:

NONE

- DISPOSITION RATIONALE -

(A) DESIGN:

VALVE BODY IS MADE OF 6061-T6 ALUMINUM ANODIZED FOR CORROSION RESISTANCE. FITTINGS ARE MADE OF 17-4 PH CONDITION A CRES, WHICH IS PRECIPITATION HARDENED CORROSION RESISTANT STEEL AND HAS A HIGH STRENGTH TO WEIGHT RATIO. STATIC SEALS ARE MADE OF SILASTIC 675 SILICONE RUBBER. POPPET IS PRESSURE COMPENSATED THROUGH THE USE OF DYNAMIC SEALS AT EACH END, WHICH SLIDE ON THE VALVE STEM. VALVE STEM IS HIGHLY POLISHED FOR EASE OF OPERATION (REDUCED FRICTION PROTECTS SEALS). DYNAMIC SEALS ARE ALSO SILASTIC 675 SILICONE AND ARE LUBRICATED WITH BRAYCO LUBE. 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. BRAYCO LUBE IS COMPATIBLE WITH LOW AND HIGH PRESSURE GO2. INLET/OUTLET PORTS ARE FILTER PROTECTED TO 25 MICRONS. CONSTANT SEAT FORCES DUE TO BELLEVILLE CLOSING SPRING ELIMINATE EXCESS SEAL AND SEAT WEAR. OPERATING FORCE IS 4.5 POUNDS MAXIMUM AND IS INDEPENDENT OF PRESSURE LOADS. THE MOST PROBABLE LEAK (TWO CUT O-RINGS WORST CASE) IS ESTIMATED AT 130 SCCM (0.0175 LB/HR).

(B) TEST:

ACCEPTANCE TEST - ATP ON VALVE INCLUDES PROOF TEST AT 1900 PSIG (1.5

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TIMES OPERATING PRESSURE) FOR A MINIMUM OF 5 MINUTES AND LEAK TEST AT 1250 PSIG WITH 2.0 SCCM MAX LEAKAGE. ATP ON N2/O2 CONTROL PANEL AS AN ASSEMBLY INCLUDES EXAMINATION OF PRODUCT, RADIOGRAPHIC INSPECTION, PROOF PRESSURE AT 1870 +/- 20 PSIG, AND EXTERNAL LEAKAGE TEST (DECAY TEST USING GN2) AT 900 +/- 15 PSIG WITH NITROGEN SYSTEM AT A LOWER PRESSURE - ENTIRE PANEL LEAKAGE IS LIMITED TO 11.0 SCCM MAX.

QUALIFICATION TEST - LIFE CYCLE TESTING - 1000 CYCLES AT 1250 PSIG. COMPONENT BURST PRESSURE IS 6700 PSIG. SUBJECTED TO THE FOLLOWING AS PART OF THE N2/O2 CONTROL PANEL: RANDOM VIBRATION SPECTRUM - 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. DESIGN SHOCK - 20G TERMINAL SAWTOOTH PULSE OF 11 MS DURATION IN EACH DIRECTION OF THREE ORTHOGONAL AXES. ATP TO VERIFY LEAKAGE IS PERFORMED AFTER SHOCK AND VIBRATION TESTING.

IN-VEHICLE TESTING - AFTER INSTALLATION THE N2/O2 CONTROL PANEL IS OVERPRESSURE (1070 - 1255 PSIG) TESTED.

DMRSD - 900, 100 PSI O2 EMERGENCY BREATHING SYSTEM 1 & 2 LEAK TEST IS PERFORMED PRIOR TO FIRST REFLIGHT AND EVERY FIVE FLIGHTS AT 900-950 PSI, 70 SCCM MAX LEAKAGE. - INFLIGHT CHECKOUT DURING EACH MISSION WILL VERIFY NO GROSS EXTERNAL LEAKAGE.

(C) INSPECTION:

RECEIVING INSPECTION

RAW MATERIAL VERIFIED BY INSPECTION AT SUPPLIER.

CONTAMINATION CONTROL

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

ASSEMBLY/INSTALLATION

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

CRITICAL PROCESSES

INLET FILTER WELD VERIFIED BY INSPECTION. PARTS PASSIVATION AND ANODIZING VERIFIED BY INSPECTION. HEAT TREATMENT VERIFIED BY INSPECTION. SOLDER CONNECTIONS VERIFIED BY INSPECTION TO BE PER NHB5300.4(3A). POTTING VISUALLY VERIFIED BY INSPECTION. APPLICATION OF LUBRICANT ON SEAL RING VERIFIED BY TECHNICIAN.

NONDESTRUCTIVE EVALUATION

LEAK TEST IS VERIFIED BY INSPECTION.

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TESTING

ATP VERIFIED BY INSPECTION. BUBBLE POINT AND DELTA P TEST OF INLET FILTER VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING, PACKAGING, STORAGE AND SHIPPING PROCEDURES ARE VERIFIED.

(D) FAILURE HISTORY:

NO FAILURE HISTORY APPLICABLE TO EXTERNAL LEAKAGE FAILURE MODE. THE ISOLATION VALVE (I.88) HAS SUCCESSFULLY BEEN USED THROUGH THE SHUTTLE PROGRAM CONSIDERING THIS FAILURE MODE.

(E) OPERATIONAL USE:

1. CREW ACTION

PERFORM LEAK ISOLATION AND HIGH O2 CONCENTRATION TROUBLESHOOTING.

2. TRAINING

STANDARD ECLSS TRAINING COVERS THE GENERIC HIGH O2 CONCENTRATION EFFECT OF THIS FAILURE.

3. OPERATIONAL CONSIDERATION

A. REQUIRES PCS O2 SYSTEM ISOLATION (NORMALLY CROSS TIED).

B. PRECLUDES USE OF LES UNLESS LEAK IS SMALL ENOUGH TO PERMIT SIMULTANEOUS LES USE PLUS O2 LEAKAGE TO CABIN.

C. REFERENCE ECLSS/FAILURE FLIGHT RULES.

D. REAL TIME DATA SYSTEM ALLOWS FOR GROUND MONITORING.

E. HIGH O2 CONCENTRATION IN CABIN REQUIRES SECOND FAILURE OR LES USAGE.

- APPROVALS -

RELIABILITY ENGINEERING:	D. R. RISING	DRR:	<u>D. R. Rising</u>
DESIGN ENGINEERING	X. KELLY	XK:	<u>X. Kelly</u>
QUALITY ENGINEERING	M. SAVALA	MS:	<u>M. Savala</u>
NASA RELIABILITY		TD:	<u>D. D. Butler 3/6/90</u>
NASA SUBSYSTEM MANAGER			<u>W. E. Stralinger 5/10/90</u>
NASA QUALITY ASSURANCE			<u>Dennis M. Hays 5/11/90</u>
			<u>Thomas K. Schmitt 9-1-90</u>