

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL HARDWARE
 NUMBER: 06-1C-0111-X

SUBSYSTEM NAME: ARS - ARPCS

REVISION: 4 08/26/93

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: N2/O2 CONTROL PANEL CARLETON TECHNOLOGIES	MC250-0002-1001 2720-0001
SRU	: VALVE, SOLENOID, OXYGEN	2722-0001-9

PART DATA

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

FUNCTION:

SOLENOID VALVE OXYGEN SYSTEM SELECTOR (1.19)

PROVIDES VALVING FOR THE TRANSFER OR ISOLATION OF AUXILIARY OXYGEN TO EITHER SYSTEM ONE OR SYSTEM TWO OXYGEN LOOPS, AND THE FLOW OF OXYGEN FROM PRSD CRYO SYSTEM TO THE LAUNCHENTRY SUITS (LES) AND AIRLOCK SYSTEMS. BOTH VALVES MUST REMAIN OPEN TO PROVIDE SUFFICIENT OXYGEN FLOW FOR LES USE. PROVIDES FOR CROSS TRANSFER OF PRSD OXYGEN TO EITHER OF THE ARPCS OXYGEN LOOPS. THE TRANSFER OF AUXILIARY OXYGEN IS APPLICABLE ONLY WHEN THE AUXILIARY OXYGEN TANK IS INSTALLED. 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: 06-101-0111-01

REVISION# 2 01/09/90

SUBSYSTEM: ARS - ARPCS
LRU :M2/O2 CONTROL PANEL
ITEM NAME: VALVE, SOLENOID, OXYGEN

CRITICALITY OF THIS
FAILURE MODE:1R2

FAILURE MODE:
INABILITY TO CLOSE, INTERNAL LEAKAGE
AUX O2 TANK NOT INSTALLED

MISSION PHASE:

PL PRELAUNCH
LD 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, PHYSICAL
BENDING/JAMMING

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 VALVE IS OPEN AND INOPERATIVE UNTIL REQUIRED.
- C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

FUNCTIONAL DEGRADATION - UNABLE TO ISOLATE ONE CRYO OXYGEN LOOP FROM
THE LES OR AIRLOCK SUBSYSTEM.

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(B) INTERFACING SUBSYSTEM(S):

INTERFACE DEGRADATION - REDUCED OPERATIONAL OPTIONS.

(C) MISSION:

NO EFFECT.

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

NO EFFECT.

(E) FUNCTIONAL CRITICALITY EFFECTS:

SECOND ASSOCIATED FAILURE (EXTERNAL LEAKAGE UPSTREAM) RESULTS IN LOSS OF LES SUPPORT CAPABILITY AND POSSIBLE LOSS OF CREW/VEHICLE.

- DISPOSITION RATIONALE -
-----**(A) DESIGN:**

VALVE BODY IS MADE OF 6061-T651 ALUMINUM ALLOY ANODIZED FOR CORROSION RESISTANCE. FITTINGS ARE MADE OF 17-4 PH CONDITION 4 CRES AND 316 CRES CONDITION A. TYPE 316 IS A STANDARD GRADE STAINLESS STEEL WHICH OFFERS THE BEST CORROSION RESISTANCE OF THE STANDARD AUSTENITIC GRADES. 17-4 PH IS PRECIPITATION HARDENED CORROSION RESISTANT STEEL WHICH HAS A HIGH STRENGTH TO WEIGHT RATIO. STATIC SEALS ARE MADE OF SILASTIC 675 SILICONE RUBBER. 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. A NICKEL BELLOWS IS UTILIZED AS A DYNAMIC SEAL WHICH CONSIDERABLY REDUCES FRICTION, STICKING, AND WEAR. THE INLET AND OUTLET PORTS ARE FILTER PROTECTED WITH 25 MICRON ABSOLUTE FILTERS. GUIDE RINGS ARE MADE OF TEFLON; METAL-TO-METAL CONTACT WITH RESULTANT CONTAMINANT PROBLEMS IS ELIMINATED.

(B) TEST:

ACCEPTANCE TEST - ATP ON VALVE INCLUDES PROOF TEST AT 1875 PSIG (1.5 TIMES MAXIMUM OPERATING PRESSURE). EXTERNAL LEAK TESTED FOR 0.2 SCCM MAX LEAKAGE AT 1250 PSIG. INTERNAL LEAK TESTED FOR 1.0 SCCM MAX LEAKAGE AT 900 PSIG FOR A MINIMUM OF 2 MINUTES. 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 - THE VALVE WAS SUBJECTED TO 50 OPEN/CLOSE CYCLES AT 900 PSIG, PRECEDING AND FOLLOWING WHICH INTERNAL LEAKAGE TESTING WAS CONDUCTED. COMPONENT BURST PRESSURE IS 2500 PSIG (2 TIMES MAXIMUM OPERATING PRESSURE). SUBJECTED TO THE FOLLOWING AS PART OF THE N2/O2 CONTROL PANEL. RANDOM VIBRATION SPECTRUM - 20 TO

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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 - INTERNAL LEAK TEST IS PERFORMED AT 925 - 950 PSIG, 10 SCCM MAX LEAKAGE.

CMRSD - INTERNAL LEAK TEST IS PERFORMED BEFORE THE FIRST REFLIGHT OF EACH ORBITER AND EVERY FIVE FLIGHTS, AND AS A CONTINGENCY FOR LRU REPLACEMENT AT 900-950 PSIG; 10 SCCM MAX LEAKAGE.

(C) INSPECTION:

RECEIVING INSPECTION

RAW MATERIAL VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL

CLEANLINESS LEVEL 200A PER MA0110-301 VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

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

NONDESTRUCTIVE EVALUATION

INSPECTION OF WELDS BY 20X VISUAL EXAM, X-RAY AND PENETRANT.

CRITICAL PROCESSES

PARTS PASSIVATION, ANODIZING AND HEAT TREATMENT VERIFIED. SOLDER CONNECTIONS VERIFIED BY INSPECTION IN ACCORDANCE WITH SPECIFICATION NHB5300.4(3A). POTTING VISUALLY INSPECTED BY INSPECTION. APPLICATION OF LUBRICANT ON SEAL RING VERIFIED BY INSPECTION. ELECTRO DEPOSITED NICKEL APPLICATION VERIFIED BY INSPECTION.

TESTING

ATP VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING, PACKAGING, STORAGE AND SHIPPING PROCEDURES ARE VERIFIED.

(D) FAILURE HISTORY:

FOUR FAILURES HAVE OCCURRED:

A9604-010, 12/4/77. AFTER SUPPLIER QTP BENCH HANDLING SHOCK TEST, SYSTEM 1 VALVE INTERNAL LEAKAGE WAS 1.3 SCCM; SYSTEM 2 WAS 4.0 SCCM.

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SHOULD BE 0.1 SCCM MAX. THE 0.1 SCCM REQUIREMENT WAS MORE DEMANDING THAN SYSTEM OPERATION REQUIREMENTS DICTATE. CORRECTIVE ACTION - ATP REQUIREMENT WAS CHANGED FROM 0.1 SCCM TO 2.0 SCCM MAX.

AB9461-010, 5/15/81. DURING ATP OF THE N2O2 CONTROL PANEL THE 1.19 VALVE INTERNAL LEAKAGE WAS 45 SCCM, SHOULD BE 1.0 SCCM MAX. SMALL PARTICLES OF 304 STAINLESS STEEL WERE FOUND INSIDE THE VALVE. THIS WAS CONSIDERED TO BE AN ISOLATED INCIDENT OF ENTRAPPED CONTAMINATION DURING ASSEMBLY AND IS ATP SCREENABLE; NO CORRECTIVE ACTION.

AC0606-010, 9/30/81. AFTER REWORK TO CORRECT A VALVE POSITION INDICATOR PROBLEM (REF CAR AC0588-010), VALVE INTERNAL LEAKAGE WAS 40 SCCM. SHOULD BE 1.0 SCCM MAX. LEAKAGE WAS ATTRIBUTED TO TOLERANCE BUILDUP. NO CORRECTIVE ACTION - FAILURE IS ATP SCREENABLE.

AD2213-010, 10/26/84. DURING CHECKOUT AT PALMDALE, SYSTEM 1 VALVE LEAKED INTERNALLY AT 25 SCCM. SHOULD BE 10 SCCM MAX. VALVE SEAT (VESPEL) WAS FOUND TO HAVE A SLIGHTLY RAISED SECTION OVER APPROXIMATELY 180 DEGREES AT THE CONTACT POINT OF THE POPPET. IT WAS SPECULATED THAT THE VALVE HAD BEEN SUBJECTED TO EXCESS GAS FLOW; EITHER A DRY GAS OR A MIXTURE OF LIQUID AND GAS. THE SUPPLIER REVIEWED THEIR TEST FACILITY AND PROCEDURES TO ASSURE DRY CLEAN GAS IS USED AT THE CORRECT PRESSURES AND FLOWS. WHITE SANDS, KSC AND PALMDALE WERE VERIFIED TO USE CLEAN DRY GAS.

(E) OPERATIONAL USE:
BS.

- APPROVALS -

RELIABILITY ENGINEERING: D. R. RISING
DESIGN ENGINEERING : K. KELLY
QUALITY ENGINEERING : M. SAVALA
NASA RELIABILITY :
NASA SUBSYSTEM MANAGER :
NASA QUALITY ASSURANCE :

DRR: E. Ockers
WBF: F. D. SANDERFELD
YMS: D. J. Burtner 5/1/90
TO: W. Steindinger 5/10/90
: Deanna M. Day 5/11/90
: Anna C. Gorman 5/11/90