

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE
NUMBER: M4-1BG-OVV20 -X

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION - CRYO, GENERIC
REVISION: 1 04/01/92

PART DATA

PART NAME	PART NUMBER
VENDOR NAME	VENDOR NUMBER
SRU : SOLENOID VALVE, EDO O2 AERODYNE	MC284-0584-1002 5660-12-000

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
O2 PALLET FILL AND VENT SERVICING SOLENOID VALVE (BIDIRECTIONAL)

REFERENCE DESIGNATORS: 40V45LV017
40V45LV076
40V45LV077
40V45LV078
40V45LV079
40V45LV016
40V45LV058
40V45LV057
40V45LV058
40V45LV059

QUANTITY OF LIKE ITEMS: 10
TEN

FUNCTION:
ISOLATES THE ASSOCIATED O2 PALLET TANK FROM THE FILL OR VENT LINE TO
PROVIDE THE CAPABILITY TO LOAD THE TANK TO THE DESIRED QUANTITY IN
CONJUNCTION WITH O2 TANK SET #3 AND THE REMAINING PALLET O2 TANKS.
PREVENTS THERMAL LOOPS AND OSCILLATIONS BETWEEN TANK SET #3 AND PALLET
TANKS.

FAILURE MODES EFFECTS ANALYSIS FMEA - CIL FAILURE MODE

NUMBER: M4-1BG-OV20-01

REVISION#: 2 03/27/96

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION - CRYO, GENERIC

LRU: SOLENOID VALVE

CRITICALITY OF THIS

ITEM NAME: SOLENOID VALVE

FAILURE MODE: 1R3

FAILURE MODE:
FAILS OPEN OR INTERNAL LEAKAGE

MISSION PHASE: LO LIFT-OFF
 OO ON-ORBIT
 DO DE-ORBIT
 LS LANDING/SAFING

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
 104 ATLANTIS
 105 ENDEAVOUR
 EDO MISSION ONLY

CAUSE:
CONTAMINATION, CORROSION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS
 B) FAIL
 C) PASS

PASS/FAIL RATIONALE:

A)

B)
SOLENOID VALVE SEALING INTEGRITY IS NONVERIFIABLE DUE TO DISCONNECT AND CAP.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

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NO EFFECT AFTER FIRST FAILURE. A FLIGHT DISCONNECT INSTALLED IN-LINE, AND A FLIGHT CAP INSTALLED ON THE DISCONNECT, PROVIDE THE PRIMARY AND SECONDARY SEAL.

(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:
GROSS LEAKAGE AS A RESULT OF FAILURES OF THE SOLENOID VALVE AND THE ASSOCIATED DISCONNECT, FLIGHT CAP, AND SUPPLY CHECK VALVE MAY RESULT IN LOSS OF ALL THREE FUEL CELL POWERPLANTS DUE TO LOSS OF SYSTEM PRESSURE IF BOTH MANIFOLD ISOLATION VALVES FAIL TO CLOSE.

-DISPOSITION RATIONALE-

(A) DESIGN:
VALVE IS SPRING-LOADED CLOSED. 50 MICRON ABS FILTER AT THE INLET. VALVE CONTAINS NO SOFT GOODS IN CONTACT WITH THE FLUID. MOVING PARTS ARE GOLD PLATED TO REDUCE FRICTION. HOUSING IS CONSTRUCTED OF CRES 304 TO PREVENT CORROSION. ALL VALVE COMPONENTS ARE COMPATIBLE WITH WORKING FLUIDS. VALVE IS MOUNTED WITH BODY AXIS PERPENDICULAR TO VEHICLE X-AXIS TO MINIMIZE VIBRATION EFFECTS. VALVE IS DESIGNED TO CLOSE WITH A MINIMUM OF 18 VOLTS (NOMINAL ORBITER BUS VOLTAGE IS 28 VOLTS).

(B) TEST:
QUALIFICATION TEST VERIFIED NORMAL OPERATION DURING SHOCK (20 G) AND VIBRATION (0.1 G SQ/HZ MAXIMUM RANDOM, +/- 0.25 G PEAK SINUSOIDAL) AND THERMAL OPERATING LIFE TEST (TOTAL OF 3000 CYCLES FROM -410 TO +220 DEG F AT OPERATING PRESSURE).

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ACCEPTANCE TEST VERIFIES FUNCTIONAL OPERATION OF MAGNETIC LATCH AND NO EXCESSIVE INTERNAL LEAKAGE. VALVE IS DIELECTRIC STRENGTH AND INSULATION RESISTANCE TESTED (10 MEGAOHMS) TO 500 VOLTS AND VERIFIED CLEANED TO LEVEL 200 BY PARTICLE COUNT. VALVE OPERATION IS FURTHER VERIFIED DURING PANEL MODULAR ASSEMBLY AND SUBSYSTEM CHECKOUT.

OMRSD: VALVE OPERATION AND INTERNAL LEAK TEST VERIFIED EVERY TURNAROUND DURING MANIFOLD PRESSURE DECAY TEST.

(C) INSPECTION:

RECEIVING INSPECTION

MATERIAL AND PROCESS CERTIFICATION DOCUMENTS ARE REVIEWED FOR COMPLIANCE WITH PROGRAM REQUIREMENTS.

CONTAMINATION CONTROL

ALL DETAIL PARTS ARE CLEANED PER ROCKWELL APPROVED SUPPLIER PROCEDURES. ALL DETAIL PARTS AND SUBASSEMBLIES ARE VISUALLY INSPECTED FOR EVIDENCE OF CONTAMINATION AT 40X MAGNIFICATION. ALL CRES DETAILS ARE PASSIVATED TO PREVENT CORROSION. THE VALVE IS VERIFIED CLEANED TO LEVEL 200.

ASSEMBLY/INSTALLATION

ALL DETAIL PARTS ARE INSPECTED UNDER 40X MAGNIFICATION FOR SURFACE FINISH BURRS AND DAMAGE. THREAD LUBRICATION, TORQUING AND LOCKWIRE ARE VERIFIED BY QC. DOCUMENTATION IS REVIEWED TO VERIFY RECORDING OF SHIM AND GAP DIMENSIONS USED TO OBTAIN AND MEASURE ARMATURE STROKE.

CRITICAL PROCESSES

THE GOLD PLATING PROCESS IS WITNESSED AND THE PLATED ARMATURE IS VISUALLY INSPECTED UNDER MAGNIFICATION FOR PLATING DEFECTS. LEAD WIRE TO CONNECTOR SOLDERING IS VERIFIED IN ACCORDANCE WITH NHB 5300.4 (3A). VALVE SEAT WELDS ARE LEAK CHECKED UNDER FULL PROOF PRESSURE AND VISUALLY INSPECTED UNDER 20X MAGNIFICATION. ELECTRON BEAM WELD PROCESS IS VERIFIED BY SECTIONING A SAMPLE VALVE SEAT TO DETERMINE WELD INTEGRITY (20X MAGNIFICATION INSPECTION).

TESTING

ALL SPRINGS ARE LOAD TESTED AT DETAIL LEVEL AND ARE LOT TRACEABLE. COIL ASSEMBLY IS TESTED AT SUBASSEMBLY LEVEL FOR INSULATION RESISTANCE, DIELECTRIC STRENGTH AND POLARITY. OPERATING VOLTAGES AND LATCH FORCES ARE CALIBRATED AND VERIFIED BY INSPECTION DURING FINAL ACCEPTANCE OF THE MAGNETIC LATCH. INTERNAL LEAKAGE IS VERIFIED LESS THAN 1200 SCCM DURING VALVE ACCEPTANCE TESTING.

HANDLING/PACKAGING

HANDLING, PACKAGING, STORAGE AND SHIPPING PROVISIONS ARE VERIFIED BY INSPECTION.

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(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE.

(E) OPERATIONAL USE:

NO CREW ACTION AFTER FAILURE. CREW WILL CLOSE MANIFOLD ISOLATION VALVE AFTER FOURTH FAILURE.

- APPROVALS -

PAE MANAGER : D. F. MIKULA
PRODUCT ASSURANCE ENGR : L. X. DANG
DESIGN ENGINEERING : G. AVILA
NASA SSMA :
NASA SUBSYSTEM MANAGER :

D.F. Mikula 29 MAR 96
L.X. Dang 3/29/96
G. Avila 3/28/96
SSMA 6/16/97
Howard B. Warner 6/16/97