FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: M4-1BG-LV011 -X

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION - CRYO, GENERIC
REVISION: 1 04/23/92

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
SRU	: SOLENOID VALVE, O2 MANIFOLD EATON CONSOLIDATED CONTROL	MC284-0429-4110 74410-4110

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
SOLENOID VALVE, O2 MANIFOLD

REFERENCE DESIGNATORS: 40V45LV011
40V45LV021

QUANTITY OF LIKE ITEMS: 2
ONE PER O2 MANIFOLD ASSY

FUNCTION:
PROVIDES CAPABILITY TO ISOLATE O2 MANIFOLD #1 FROM MANIFOLD #2.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: M4-16G-LV011-02

REVISION# 1 R

SUBSYSTEM: ELECTRICAL POWER GENERATION - CRYO, GENERIC

ITEM NAME: SOLENOID VALVE, O2 MANIFOLD

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
FAILS CLOSED

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

CRITICALITY 1/1 DURING INTACT ABORT ONLY? N

REDUNDANCY SCREEN A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
FAILURE WOULD RESULT IN TANK QUANTITY AND PRESSURE IMBALANCE DUE TO UNEVEN DISTRIBUTION OF CONSUMABLES.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: M4-1BG-LV011-02

■ (B) INTERFACING SUBSYSTEM(S):
NO EFFECT AFTER FIRST FAILURE.

■ (C) MISSION:
SAME AS (B)

■ (D) CREW, VEHICLE, AND ELEMENT(S):
SAME AS (B)

■ (E) FUNCTIONAL CRITICALITY EFFECTS:
FUNCTIONAL CRITICALITY EFFECTS- AN ADDITIONAL FAILURE WHICH RESULTS IN LOSS OF EITHER O2 TANK SUPPLIES 1 OR 2 LOCATED IMMEDIATELY UPSTREAM OF THE FAILED CLOSED MANIFOLD VALVE, MAY RESULT IN INSUFFICIENT O2 FLOW TO THE LAUNCH/ENTRY SUIT (LES). LOSS OF THIS EMERGENCY SYSTEM MAY RESULT IN LOSS OF CREW/VEHICLE.

- DISPOSITION RATIONALE -

■ (A) DESIGN:
VALVE IS MAGNETICALLY LATCHED. 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. FAILURE MODE IS ON FAULT DETECTION AND ANNUNCIATION. VALVE IS DESIGNED TO OPEN 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 -284 TO +220 DEG F AT OPERATING PRESSURE).

ACCEPTANCE TEST VERIFIES FUNCTIONAL OPERATION OF MAGNETIC LATCH AND THAT PRESSURE DROP IS WITHIN LIMITS. VALVE IS VERIFIED CLEANED TO LEVEL 200A BY PARTICLE COUNT AND NON-VOLATILE RESIDUE. VALVE IS FURTHER VERIFIED DURING PANEL MODULAR ASSEMBLY AND SUBSYSTEM CHECKOUT.

OMRSD: VALVE OPERATION VERIFIED ~~EVERY TURNAROUND DURING MANIFOLD PRESSURE DECAY TEST~~ IN FLIGHT HW

■ (C) INSPECTION:
RECEIVING INSPECTION
MATERIAL AND PROCESS CERTIFICATION DOCUMENTS ARE REVIEWED FOR

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: M4-186-LV011-02

COMPLIANCE WITH PROGRAM REQUIREMENTS.

ASSEMBLY/INSTALLATION
ALL DETAIL PARTS ARE INSPECTED UNDER 40X MAGNIFICATION FOR SURFACE FINISH BURRS AND DAMAGE. THREAD LUBRICATION, TORQUING AND LOCKWIRE ARE VERIFIED BY INSPECTION. 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. LATCH FORCES ARE CALIBRATED AND VERIFIED BY INSPECTION DURING FINAL ACCEPTANCE OF THE MAGNETIC LATCH. VALVE ACCEPTANCE TEST REQUIREMENTS, INCLUDING INTERNAL/EXTERNAL LEAKAGE AND PRESSURE DROP, ARE VERIFIED BY INSPECTION. VALVE PRESSURE DROP/FLOWRATE IS VERIFIED DURING ACCEPTANCE TEST.

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

- (D) FAILURE HISTORY:
THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH THIS FAILURE MODE.

- (E) OPERATIONAL USE:
CREW WOULD ATTEMPT TO REOPEN VALVE. IF UNSUCCESSFUL, GROUND WILL RECOMMEND CRYO MANAGEMENT PLAN BASED UPON THE SITUATION.

- APPROVALS -

RELIABILITY ENGINEERING	M. O. WEST	M D. West for E. Olson
DESIGN ENGINEERING	M. M. SCHEIERN	M. M. Scheiern
QUALITY MANAGER	O. J. BUTTNER	E. Olson
NASA RELIABILITY		[illegible]
NASA SUBSYSTEM MANAGER		[illegible] 4/9/92
NASA QUALITY ASSURANCE		[illegible] 4/6/92