PRINT DATE: 06/21/97

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: M4-1BG-A01FSO -X

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION - CRYO, GENERIC
REVISION: 3 03/25/96

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
SRU	: LINES, COMPONENTS & FITTINGS	M072-454001
SRU	: LINES, COMPONENTS & FITTINGS	M072-454002
SRU	: LINES, COMPONENTS & FITTINGS	M072-454004
SRU	: LINES, COMPONENTS & FITTINGS	M072-454006
SRU	: LINES, COMPONENTS & FITTINGS	M072-454008
SRU	: LINES, COMPONENTS & FITTINGS	M072-454011
SRU	: LINES, COMPONENTS & FITTINGS	M072-454012
SRU	: LINES, COMPONENTS & FITTINGS	V070-454011
SRU	: LINES, COMPONENTS & FITTINGS	V070-454021
SRU	: LINES, COMPONENTS & FITTINGS	V070-454031
SRU	: LINES, COMPONENTS & FITTINGS	V070-454041
SRU	: LINES, COMPONENTS & FITTINGS	V070-454051
SRU	: LINES, COMPONENTS & FITTINGS	V070-454052
SRU	: LINES, COMPONENTS & FITTINGS	V070-454061
SRU	: LINES, COMPONENTS & FITTINGS	V070-454062
SRU	: LINES, COMPONENTS & FITTINGS	V070-454013
SRU	: LINES, COMPONENTS & FITTINGS	V070-454906
SRU	: LINES, COMPONENTS & FITTINGS	V070-454907
SRU	: LINES, COMPONENTS & FITTINGS	V070-454908
SRU	: LINES, COMPONENTS & FITTINGS	V070-454909
SRU	: LINES, COMPONENTS & FITTINGS	V070-454928

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SRU	: LINES, COMPONENTS & FITTINGS	V070-454929
SRU	: LINES, COMPONENTS & FITTINGS	V070-454946
SRU	: LINES, COMPONENTS & FITTINGS	V070-454947
SRU	: LINES, COMPONENTS & FITTINGS	V070-454948
SRU	: LINES, COMPONENTS & FITTINGS	V070-454949
SRU	:LINES, COMPONENTS & FITTINGS	V070-454014
SRU	:LINES, COMPONENTS & FITTINGS	V070-454015
SRU	:LINES, COMPONENTS & FITTINGS	V070-454009
SRU	:LINES, COMPONENTS & FITTINGS	M454100
SRU	:LINES, COMPONENTS & FITTINGS	V458-454002

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
LINES, COMPONENTS AND FITTINGS, O2

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 1
ONE

FUNCTION:
LINES, COMPONENTS AND FITTINGS DISTRIBUTE O2 FROM THE STORAGE TANK SUBASEMBLIES TO THE FUEL CELLS AND THE ECLSS.

- APPROVALS -

PRODUCT ASSURANCE ENGR : J. NGUYEN
DESIGN ENGINEERING : T. D. NGUYEN
EDITORIALLY APPROVED JSC

7/2/97
7/2/97
9-12-97

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE NUMBER: M4-1BG-A01FSO-01

REVISION# 2 12/09/92

SUBSYSTEM: ELECTRICAL POWER GENERATION - CRYO, GENERIC

ITEM NAME: LINES, COMPONENTS & FITTINGS **CRITICALITY OF THIS FAILURE MODE:1/1**

FAILURE MODE:
EXTERNAL LEAKAGE

MISSION PHASE:

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, OVERPRESSURE, MISHANDLING

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:
SUBSYSTEM DEGRADATION - LOSS OF O2 SUPPLY. EXCESSIVE LOSS OF O2 WOULD REQUIRE RECONFIGURATION OF THE SYSTEM TO ISOLATE LEAK. POSSIBLE LOSS OF SEVEN O2 TANK SUPPLIES (O2 TANKS 3 THROUGH 9).

(B) INTERFACING SUBSYSTEM(S):
DEGRADATION OF INTERFACE FUNCTION - LEAK ISOLATION MAY RESULT IN LOSS

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: M4-1BG-A01FSO-01

OF O2 REACTANT SUPPLY TO ONE FUEL CELL POWERPLANT. LOSS OF FCP1/BUS "A" OR FCP3/BUS "C" IS LOSS OF OMS ENGINE PURGE CAPABILITY, WHICH IS REQUIRED FOR TAL AND AFT COMPARTMENT MPS HELIUM PURGE CAPABILITY, WHICH IS REQUIRED FOR RTLS AND TAL.

(C) MISSION:
ABORT DECISION.

(D) CREW, VEHICLE, AND ELEMENT(S):
GROSS LEAKAGE OF O2 MAY RESULT IN LOSS OF ALL THREE FUEL CELL POWERPLANTS, DUE TO LOSS OF SYSTEM PRESSURE BEFORE LEAK ISOLATION COULD BE PERFORMED (DEPRESSURIZATION OCCURS IN 7 SECONDS WORST CASE). ALSO, UNDETECTED OR UNISOLATABLE LEAKAGE OF O2 MAY RESULT IN EXPLOSIVE MIXTURE IN THE MIDBODY DURING ENTRY.

(E) FUNCTIONAL CRITICALITY EFFECTS:
NONE

- DISPOSITION RATIONALE -

(A) DESIGN:
RELIEF VALVE PROTECTION FOR OVERPRESSURE CONDITIONS PROVIDING AT LEAST ONE MANIFOLD VALVE IS OPEN. LINE DESIGN BURST PRESSURE IS A MINIMUM OF 4 TIMES WORKING PRESSURE. COMPONENT DESIGN BURST PRESSURE IS A MINIMUM OF 2 TIMES WORKING PRESSURE. OV-103, OV-104, AND OV-105 FITTINGS ARE SAFETY-WIRED. LINES, FITTINGS AND COMPONENTS ARE VIBRATION-ISOLATED FROM VEHICLE STRUCTURE. MATERIALS ARE CORROSION RESISTANT AND COMPATIBLE WITH WORKING FLUIDS. CREW PROVIDED WITH CAUTION AND WARNING FOR OVERPRESSURE. ANALYSIS HAS DETERMINED THAT TUBING INSTALLATION IS COMPATIBLE WITH G LOADS IN THE 40 TO 50 G RANGE WHICH IS IN EXCESS OF EXPECTED CRASH AND LANDING SHOCK REQUIREMENTS. PRELAUNCH GN2 MID-BODY PURGE PROVIDES INERT ENVIRONMENT THROUGHOUT LIFT-OFF PHASE.

(B) TEST:
PLUMBING ASSEMBLY QUALIFICATION TEST INCLUDED: VIBRATION-RANDOM (0.01 G SQ/HZ TO 300 HZ), SINUSOIDAL (+/- 0.25 G PEAK) AND ACOUSTIC (25 TO 800 HZ, 130-148 DB FOR 175 MISSION EQUIVALENT), 100 THERMAL CYCLES (AMBIENT/CRYO/+200 DEG F/AMBIENT/CRYO/AMBIENT).

PRELAUNCH MIDBODY INERT PURGE WILL DETECT HAZARDOUS LEAKAGE OF REACTANTS. LINES AND COMPONENTS PROOF PRESSURED AND THERMALLY CYCLED DURING QUALIFICATION TEST. FITTINGS AND JOINTS LEAK TESTED AND PROOF PRESSURED DURING PRSD SUBSYSTEM TEST AND CHECKOUT AFTER INSTALLATION. FITTINGS ARE LEAK CHECKED WHEN COMPONENTS ARE REMOVED AND REPLACED. GSE WORK-ACCESS PLATFORMS ARE PLACED IN THE LOWER MID-FUSELAGE FOR TRAINED PERSONNEL TO PERFORM WORK ON THE SYSTEM. VEHICLE ACCESS IS LIMITED TO ESSENTIAL PERSONNEL ONLY.

OMRSD: PRSD SYSTEM PRESSURE DECAY CHECK PERFORMED EVERY TURNAROUND.

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(C) INSPECTION:
RECEIVING INSPECTION
ALL METALLIC RAW MATERIAL INCLUDING TUBING IS VERIFIED FOR CHEMISTRY. PHYSICAL PROPERTIES ARE VERIFIED BY LAB ANALYSIS (LOT SAMPLED).

CONTAMINATION CONTROL
CLEANLINESS PER SPECIFICATION TO LEVEL 200A (TUBES) IS VERIFIED BY INSPECTION PERSONNEL.

ASSEMBLY/INSTALLATION
COMPLIANCE WITH REQUIREMENTS SPECIFIED ON ALL MANUFACTURING ORDERS IS VERIFIED BY INSPECTION PERSONNEL. AT ASSEMBLY, THE FOLLOWING ARE VERIFIED BY INSPECTION PERSONNEL: CORROSION PROTECTION FOR THREADED AND BLIND FASTENERS. DURING LINE INSTALLATION, TUBING BEND RADII, TUBING SUPPORT INTERVALS, AND PROXIMITY TO ELECTRICAL LINES ARE VERIFIED ACCEPTABLE. DYNATUBE FITTINGS ARE VERIFIED FOR ALIGNMENT AND GAP. SYSTEM IS VERIFIED FOR CLEANLINESS. TORQUE CODED FITTINGS ARE VERIFIED PER SPECIFIED TORQUE REQUIREMENTS. SUPPLIER HARDWARE IS INSPECTED PER MIPS CONTAINED IN THE QUALITY PLANNING REQUIREMENTS DOCUMENT.

NONDESTRUCTIVE EVALUATION
RADIOGRAPHIC INSPECTION IS APPLIED AND VERIFIED BY INSPECTION PERSONNEL RELATIVE TO BRAZING.

CRITICAL PROCESSES
INDUCTION BRAZE IS VERIFIED BY INSPECTION PERSONNEL.

TESTING
CONNECTIONS AND COMPONENTS ARE LEAK TESTED AT MAXIMUM OPERATING PRESSURE AND PROOF PRESSURE TESTED TO 1.5 TIMES MAXIMUM OPERATING PRESSURE. SAMPLE TUBING BENDS ARE FABRICATED AND SECTIONED TO VERIFY MINIMUM WALL THICKNESS AND MATERIAL HARDNESS AT AREA OF MINIMUM THICKNESS.

HANDLING/PACKAGING
INSPECTION PERSONNEL VERIFY THAT PARTS ARE PACKAGED AND PROTECTED PER REQUIREMENTS.

(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 PERFORM ONE OR MORE OF THE FOLLOWING: (1) DEACTIVATE TANK HEATERS; (2) CLOSE MANIFOLD VALVES; (3) SHUT DOWN FUEL CELLS.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: M4-1BG-A01F80-01

- APPROVALS -

PAE MANAGER	: T. J. EAVENSON	: K.L. Quate for 12/14/92
PRODUCT ASSURANCE ENGR	: T. K. KIMURA	: T K Kimura 12/9/92
DESIGN ENGINEERING	: M. M. SCHEIERN	: M.M. Scheiern 12/14/92
NASA RELIABILITY	:	: Jeffrey H. Cyphert 1-25-9
NASA SUBSYSTEM MANAGER	:	: Kenneth A. Hodges 1-25-93
NASA QUALITY ASSURANCE	:	: Jeffrey H. Cyphert 1-25-