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PRINT DATE: 08/18/95

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE

NUMBER: M8-1MR-M014-X

SUBSYSTEM NAME: MECHANICAL - EXTERNAL AIRLOCK

REVISION: 3 8/15/95

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: PLUG, LEAK TEST PORT	ME276-0040-0001

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
EXTERNAL AIRLOCK AFT HATCH LEAK TEST PORT PLUG**REFERENCE DESIGNATORS:****QUANTITY OF LIKE ITEMS: 1**
ONE**FUNCTION:**

THIS PLUG PROVIDES A SEAL FOR THE LEAK TEST PORT CONNECTED TO THE VOLUME BETWEEN THE DUAL (REDUNDANT) PERIMETER SEALS AROUND EXTERNAL AIRLOCK AFT HATCH. THIS PORT IS USED WITH A PNEUMATIC PORTABLE TEST KIT (G70-0749) TO VERIFY HATCH SEAL INTEGRITY PRIOR TO LAUNCH (AFTER OPENING/CLOSING THE HATCH).

REFERENCE DOCUMENTS: M072-593828

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FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE
NUMBER: MS-1MR-M014-01

REVISION# 3 9/18/95

SUBSYSTEM NAME: MECHANICAL - EXTERNAL AIRLOCK
LRU: PLUG, LEAK TEST PORT
ITEM NAME: O-RING SEALS

CRITICALITY OF THIS FAILURE MODE: 1R3

FAILURE MODE:
EXTERNAL LEAKAGE

MISSION PHASE:
OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 104 ATLANTIS

CAUSE:
AGING/OXIDATION/SUBLIMATION, CONTAMINATION/FOREIGN OBJECT/DEBRIS, DEFECTIVE PART MATERIAL OR MANUFACTURING DEFECT, INADEQUATE/EXCESSIVE/UNEVEN SEAL COMPRESSION LOADS, MISHANDLING, THERMAL DISTORTION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? N/A

REDUNDANCY SCREEN **A) FAIL**
 B) N/A
 C) PASS

PASS/FAIL RATIONALE:

A)
FAILS SCREEN "A" BECAUSE INDIVIDUAL TEST PORT PLUG SEAL NOT VERIFIABLE ON VEHICLE DURING GROUND CHECKOUT.

B)
N/A - AT LEAST TWO REMAINING PATHS ARE DETECTABLE IN FLIGHT.

C)

METHOD OF FAULT DETECTION:
NONE FOR FAILURE OF BOTH LEAK TEST PORT PLUG SEALS. ADDITIONAL FAILURE OF EXTERNAL AIRLOCK AFT HATCH INNER O-RING SEAL CAN BE DETECTED THROUGH INSTRUMENTATION & PHYSICAL OBSERVATION - LOSS OF PRESSURE (CONSUMABLES) IN SPACELAB DURING EVA (MR 1) OR LOSS OF PRESSURE (CONSUMABLES) IN ODS DURING IVA (MULT-MR).

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NO EFFECT FIRST AND SECOND FAILURE. TWO SUCCESSIVE PLUG O-RING FAILURES WILL CAUSE ONLY THE LOSS OF EXTERNAL AIRLOCK AFT HATCH OUTER SEAL INTEGRITY. THE EXTERNAL AIRLOCK AFT HATCH INNER O-RING SEAL MUST ALSO FAIL

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**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: M8-1MR-M014-01****TO CAUSE A LOSS OF ISOLATION BETWEEN EXTERNAL AIRLOCK AND SPACELAB FOR
MIR 1 OR BETWEEN EXTERNAL AIRLOCK AND OUTSIDE ENVIRONMENT FOR MULTI-MIR.****(B) INTERFACING SUBSYSTEM(S):**

NO EFFECT UNTIL LOSS OF BOTH PLUG O-RING SEALS AND LOSS OF EXTERNAL AIRLOCK AFT HATCH INNER SEAL THEN LEAKAGE ACROSS AFT HATCH WILL OCCUR.
MIR 1 - LOSS OF SPACELAB CONSUMABLES IF EVA "C" HATCH IS OPENED AND LEFT OPEN DURING DURATION OF EVA. REPRESSURIZATION OF ODS FOLLOWING EVA WILL RESULT IN EXCESSIVE LEAKAGE OF CONSUMABLES INTO SPACELAB VACUUM. NO EFFECT DURING IVA SINCE EXTERNAL AIRLOCK AFT HATCH REMAINS OPEN.
MULTI-MIR - LOSS OF PRESSURE TO OUTSIDE ATMOSPHERE AND INCREASED USE OF O2/N2 CONSUMABLES.

(C) MISSION:

MIR 1 - NO EFFECT DURING DOCKED MISSION SINCE EXTERNAL AIRLOCK AFT HATCH IS OPEN DURING IVA. FAILURE OF BOTH TEST PORT PLUG SEALS AND INNER PERIPHERAL SEAL ON EXTERNAL AIRLOCK AFT HATCH WILL LOSE CAPABILITY TO PERFORM A PLANNED EVA SINCE ODS AND SPACELAB VOLUMES CANNOT BE REPRESSURIZED TOGETHER FOLLOWING AN EVA.
MULTI-MIR - NO EFFECT FIRST FAILURE. FAILURE OF BOTH TEST PORT COUPLING SEALS AND INNER PERIPHERAL SEAL ON EXTERNAL AIRLOCK AFT HATCH WOULD RESULT IN LOSS OF EXTERNAL AIRLOCK PRESSURIZATION. POSSIBLE LOSS OF MISSION IF LOSS OF PRESSURIZATION OCCURS PRIOR TO COMPLETION OF IVA.

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

NO EFFECT FIRST FAILURE. POSSIBLE LOSS OF EVA CREWMEMBERS IF FAILURE OF REDUNDANT TEST PORT PLUG SEAL AND EXTERNAL AIRLOCK AFT HATCH INNER O-RING SEAL OCCUR DURING EVA (MIR 1 & 2). LOSS OF ODS PRESSURE (CONSUMABLES) COULD JEOPARDIZE SAFETY OF CREW AND VEHICLE (MULTI-MIR ONLY).

(E) FUNCTIONAL CRITICALITY EFFECTS:

FIRST LEAK TEST PORT PLUG O-RING SEAL FAILURE - NO EFFECT.
SECOND LEAK TEST PORT PLUG O-RING SEAL FAILURE - LOSS OF EXTERNAL AIRLOCK AFT HATCH OUTER SEAL INTEGRITY.
THIRD FAILURE (EXTERNAL AIRLOCK AFT HATCH INNER O-RING SEAL):
MIR 1 - LOSS OF SPACELAB CONSUMABLES DURING EVA. POSSIBLE LOSS OF CAPABILITY TO REPRESSURIZE INTERNAL AIRLOCK, TUNNEL ADAPTER, EXTERNAL AIRLOCK, AND SPACELAB VOLUMES DUE TO LACK OF AVAILABLE O2/N2. LOSS OF EVA CREW MEMBERS IF EVA IS PERFORMED AND HABITABLE VOLUMES CANNOT BE REPRESSURIZED FOR CREW RETURN TO CABIN (EVA CREW MEMBERS MUST REMAIN IN AIRLOCK UNTIL LANDING).
MULTI-MIR - (1) IF THIRD FAILURE OCCURS DURING IVA EXCESSIVE LOSS OF CONSUMABLES CAN JEOPARDIZE CREW SAFETY; (2) IF THIRD FAILURE OCCURS DURING EVA OUT EXTERNAL AIRLOCK, POSSIBLE LOSS OF EVA CREWMEMBERS IF EXTERNAL AIRLOCK VOLUME CANNOT BE REPRESSURIZED FOR RETURN TO CREW CABIN. (EVA CREWMEMBERS MUST REMAIN IN AIRLOCK UNTIL LANDING);
IF THIRD FAILURE OCCURS WHEN ORBITER/MIR ARE DOCKED, POSSIBLE LOSS OF PRESSURE IN MIR WHEN EXTERNAL AIRLOCK UPPER HATCH IS OPEN.

DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 1R3

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**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: MS-1MR-M014-01**

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

FOURTH & FIFTH FAILURE (INABILITY TO CLOSE APPROPRIATE HATCH(S)) - FAILURE TO ISOLATE LEAKAGE FROM CREW CABIN RESULTING IN POTENTIAL LOSS OF CREW AND VEHICLE.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: HOURS TO DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: MINUTES

TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: SECONDS TO MINUTES

**IS TIME REQUIRED TO IMPLEMENT CORRECTIVE ACTION LESS THAN TIME TO EFFECT?
YES**

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:

CREW WOULD HAVE SUFFICIENT TIME TO CLOSE APPROPRIATE HATCH(S) TO ISOLATE LEAKAGE FROM THE CREW CABIN VOLUME BEFORE EXCESSIVE LEAKAGE BECAME CATASTROPHIC.

HAZARDS REPORT NUMBER(S): ORBI 511

**HAZARD(S) DESCRIPTION:
LOSS OF HABITABLE PRESSURE.**

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

O-RING SEALS IN LEAK TEST PORT COUPLING ARE ETHYLENE PROPYLENE. O-RING SEAL AT COUPLING INTERFACE FLANGE IS BUTYL RUBBER. PROTECTIVE PRESSURE CAP SEAL IS REDUNDANT TO POPPET VALVE SEAL WHEN TEST PORT COUPLING IS NOT IN USE. TEST PORT COUPLING SEAL LEAKAGE WILL NOT RESULT IN LEAKAGE BETWEEN EXTERNAL AIRLOCK AND SPACELAB UNLESS EXTERNAL AIRLOCK AFT HATCH INNER PERIPHERAL O-RING SEAL ALSO FAILS.

(B) TEST:

ACCEPTANCE TESTS OF LEAK TEST PORT COUPLING INCLUDE EXAMINATION OF PRODUCT, PROOF PRESSURE TEST AND OPERATIONAL TEST. PROOF PRESSURE TEST OF THE LEAK TEST PORT (MALE HALF COUPLING) WITH PRESSURE CAP INSTALLED IS 30 PSIG TWO TIMES FOR TWO MINUTES EACH. OPERATIONAL TEST OF THE LEAK TEST PORT WITH PRESSURE CAP INSTALLED AND POPPET HELD OPEN IS 15 PSIG GN2 WITH LEAKAGE NOT TO EXCEED ONE BUBBLE IN FIVE MINUTES. WITH PRESSURE CAP REMOVED AND 15 PSIG APPLIED, LEAKAGE IS NOT TO EXCEED ONE BUBBLE IN FIVE MINUTES.

QUALIFICATION TESTS: NO QUALIFICATION TESTS OF COUPLING WERE PERFORMED.

OMRSD - TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

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FAILURE MODES EFFECTS ANALYSIS (FMEA) - GIL FAILURE MODE NUMBER: MS-1MR-M014-01

(C) INSPECTION:

RECEIVING INSPECTION RAW MATERIAL IS VERIFIED BY INSPECTION TO ASSURE SPECIFIC SHUTTLE REQUIREMENTS ARE SATISFIED.

CONTAMINATION CONTROL

CLEANLINESS OF SIGNIFICANT INTERNAL AND EXTERNAL SURFACES TO LEVEL GC (GENERALLY CLEAN) OF MA0110-301 IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

OPERATIONS VERIFIED BY ASSEMBLY AND TEST OPERATIONS ON SHOP TRAVELER.

CRITICAL PROCESSES

CRITICAL PROCESSES SUCH AS WELDING, PLATING, HEAT TREATING, PASSIVATION AND ANODIZING ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

NO NONDESTRUCTIVE EVALUATION (NDE) IS DONE/PERFORMED.

TESTING

ATP/OMRSD IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING AND PACKAGING IS VERIFIED BY INSPECTION PER THE REQUIREMENTS OF SPECIFICATION MA0110-301.

(D) FAILURE HISTORY:

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

(E) OPERATIONAL USE:

NONE FOR FAILURE OF BOTH LEAK TEST PORT PLUG SEALS. ADDITIONAL FAILURE OF EXTERNAL AIRLOCK AFT HATCH INNER O-RING SEAL - RATE OF LEAKAGE AND THE FEASIBILITY OF COMPLETING THE MISSION OR EVA CAN BE DETERMINED (MIR 1). CREW COULD CLOSE APPROPRIATE HATCH(S) TO ISOLATE LEAKAGE GIVEN AN ADDITIONAL FAILURE OF EXTERNAL AIRLOCK AFT HATCH INNER O-RING SEAL (MULTI-MIR).

- APPROVALS -

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