FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: M8-1MR-M013-X

SUBSYSTEM NAME: MECHANICAL - EXTERNAL AIRLOCK
REVISION: 3 9/15/95

		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 UPPER 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 UPPER HATCH. THIS PORT IS USED WITH A PNEUMATIC PORTABLE TEST KIT (C70-0749) TO VERIFY HATCH SEAL INTEGRITY PRIOR TO LAUNCH (AFTER OPENING/CLOSING THE HATCH).

REFERENCE DOCUMENTS: M072-583829

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SUBSYSTEM NAME: MECHANICAL - EXTERNAL AIRLOCK
LRU: PLUG, LEAK TEST PORT CRITICALITY OF THIS
ITEM NAME: O-RING SEALS 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 UPPER HATCH INNER O-RING SEAL CAN BE DETECTED THROUGH INSTRUMENTATION & PHYSICAL OBSERVATION - LOSS OF ODS PRESSURE.

- FAILURE EFFECTS -

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

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(B) INTERFACING SUBSYSTEM(S):
NO EFFECT UNTIL LOSS OF BOTH PLUG O-RING SEALS AND LOSS OF EXTERNAL AIRLOCK UPPER HATCH INNER SEAL. THEN LOSS OF PRESSURE TO OUTSIDE ATMOSPHERE AND INCREASED USE OF O2/N2 CONSUMABLES WILL OCCUR WHEN ORBITER AND MIR ARE NOT DOCKED. INABILITY TO DEPRESSURIZE VESTIBULE TUNNEL FOR SEPARATION WITHOUT EFFECTING ODS VOLUMES.

(C) MISSION:
NO EFFECT DURING DOCKED MISSION SINCE EXTERNAL AIRLOCK UPPER HATCH IS OPEN DURING IVA. FAILURE OF BOTH TEST PORT PLUG SEALS AND INNER PERIPHERAL SEAL ON UPPER HATCH PRIOR TO MIR DOCKING WOULD RESULT IN LOSS OF ODS PRESSURIZATION AND EARLY MISSION TERMINATION.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT FIRST FAILURE. LOSS OF CAPABILITY TO PERFORM EVA OR LOSS OF EVA CREWMEMBERS FOLLOWING EVA, IF FAILURE OF REDUNDANT TEST PORT COUPLING SEAL AND EXTERNAL AIRLOCK UPPER HATCH INNER O-RING SEAL OCCUR WHEN ORBITER AND MIR ARE NOT DOCKED.

(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 UPPER HATCH OUTER SEAL INTEGRITY.
THIRD FAILURE (EXTERNAL AIRLOCK UPPER HATCH INNER O-RING SEAL):
WHEN ORBITER/MIR ARE NOT DOCKED; (1) IF THIRD FAILURE OCCURS DURING IVA (CAMERA PREPARATION FOR DOCKING OR SPACELAB OPERATIONS (MIR 1 ONLY)) 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 IF ISOLATION BETWEEN EXTERNAL AIRLOCK AND MIR IS LOST WHEN EXTERNAL AIRLOCK IS DEPRESSURIZED FOR EVA.

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

(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

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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 WHEN ORBITER AND MIR ARE NOT DOCKED.

-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 OF HABITABLE ATMOSPHERE OVERBOARD UNLESS EXTERNAL AIRLOCK UPPER 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.

(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.

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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 O-RING SEALS. CREW COULD CLOSE APPROPRIATE HATCH(S) TO ISOLATE LEAKAGE GIVEN AN ADDITIONAL FAILURE OF THE EXTERNAL AIRLOCK UPPER HATCH INNER O-RING SEAL WHEN ORBITER AND MIR ARE NOT DOCKED.

- APPROVALS -

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