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FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: M8-1MR-M015-X

SUBSYSTEM NAME: MECHANICAL - EXTERNAL AIRLOCK
REVISION: 2 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 FORWARD AND AFT ADAPTER LEAK TEST PORT PLUG

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 4
FOUR

FUNCTION:
THIS PLUG PROVIDES A TEST PORT FOR THE DUAL (REDUNDANT) STRUCTURAL SEALS LOCATED ON THE FORWARD AND AFT PERIMETERS OF BOTH THE EXTERNAL AIRLOCK FORWARD AND AFT ADAPTERS. THIS PORT IS USED WITH A PNEUMATIC PORTABLE TEST KIT (C70-0749) TO VERIFY STRUCTURAL SEAL INTEGRITY PRIOR TO LAUNCH.

REFERENCE DOCUMENTS: V628-342051
V628-342054
V628-342151
V628-342154

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: M8-1MR-M015-01

REVISION# 2 9/15/95

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

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 OUTER STRUCTURAL O-RING SEAL ON AFFECTED ADAPTER (FWD OR AFT) CAN BE DETECTED THROUGH INSTRUMENTATION/PHYSICAL OBSERVATION - LOSS OF OR REDUCED PRESSURE IN HABITABLE VOLUMES.

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NO EFFECT FIRST AND SECOND FAILURE. TWO SUCCESSIVE PLUG O-RING FAILURES WILL CAUSE ONLY THE LOSS OF OUTER STRUCTURAL SEAL INTEGRITY. THE INNER STRUCTURAL O-RING SEAL MUST ALSO FAIL TO CAUSE A LOSS OF ISOLATION BETWEEN ODS AND OUTSIDE ATMOSPHERE.

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(B) INTERFACING SUBSYSTEM(S):
NO EFFECT UNTIL LOSS OF BOTH PLUG O-RING SEALS AND LOSS OF INNER STRUCTURAL SEAL. THEN EXCESSIVE LOSS OF ODS PRESSURE TO THE OUTSIDE WILL RESULT IN AN INCREASED USE OF OXYGEN/NITROGEN SUPPLY.

(C) MISSION:
NO EFFECT FIRST FAILURE. FAILURE OF REDUNDANT TEST PORT PLUG SEAL AND OUTER STRUCTURAL SEAL ON AFFECTED ADAPTER (FWD OR AFT) WOULD RESULT IN POSSIBLE MISSION TERMINATION DEPENDING ON MAGNITUDE OF LEAK. EXCESSIVE USE OF CONSUMABLES MAY LIMIT MISSION DURATION.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT FIRST FAILURE. FAILURE OF REDUNDANT TEST PORT PLUG SEAL AND OUTER STRUCTURAL SEAL ON AFFECTED ADAPTER (FWD OR AFT) COULD CAUSE LOSS OF CREW AND VEHICLE.

(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 OUTER STRUCTURAL SEAL INTEGRITY ON AFFECTED ADAPTER (FWD OR AFT).
THIRD FAILURE (INNER STRUCTURAL O-RING SEAL ON AFFECTED FWD/AFT ADAPTER): (1) LOSS OF CONSUMABLES IN ODS AND SPACELAB ENVIRONMENT (MIR 1 ONLY) WITH ALL INTERNAL HATCHES OPEN. SAFETY OF CREWMEMBERS IS JEOPARDIZED UPON LOSS OF CONSUMABLES; (2) FOLLOWING EVA - POSSIBLE LOSS OF CAPABILITY TO REPRESSURIZE HABITABLE VOLUME(S) DUE TO LACK OF AVAILABLE O2/N2. LOSS OF EVA CREW MEMBERS IF EVA IS PERFORMED AND HABITABLE VOLUME(S) CANNOT BE REPRESSURIZED FOR CREW RETURN TO CABIN (EVA CREW MEMBERS MUST REMAIN IN AIRLOCK UNTIL LANDING); AND (3) POSSIBLE LOSS OF PRESSURE IN MIR IF THIRD FAILURE OCCURS WHILE MIR HATCH IS OPEN.

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

(F) RATIONALE FOR CRITICALITY DOWNGRADE:
FOURTH FAILURE (INABILITY TO CLOSE APPROPRIATE HATCH) - 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.

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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 OF HABITABLE ATMOSPHERE OVERBOARD UNLESS AFT/FWD ADAPTER INNER PERIPHERAL O-RING STRUCTURAL 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.

NONDESTRUCTIVE EVALUATION
NO NONDESTRUCTIVE EVALUATION (NDE) IS DONE/PERFORMED.

TESTING
ATP/OMRSD VERIFIED BY INSPECTION.

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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 ASSOCIATED EXTERNAL AIRLOCK ADAPTER INNER O-RING SEAL - GIVEN SUFFICIENT TIME CREW COULD CLOSE APPROPRIATE HATCH(S) TO ISOLATE LEAKAGE.

- APPROVALS -

PRODUCT ASSURANCE ENGR	: M. W. GUENTHER	:
PAE MANAGER	: W. R. MARLOWE	:
DESIGN ENGINEER	: T. S. COOK	:
CHIEF ENGINEER	: B. J. BRANDT	:
NASA SSMA	:	:
NASA SUBSYSTEM MANAGER	:	:
JSC MOD	:	: