

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE
 NUMBER: M8-1SS-M016 -X

SUBSYSTEM NAME: MECHANICAL - SEALS

REVISION: 1

04/08/87

 PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:KIT, EXTERNAL AIRLOCK MISSION	V828-000002
SRU	:SEAL, FEEDTHROUGH PLATE	M83248/1-381

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
 EXTERNAL AIRLOCK/FWD ADAPTER/FWD TUNNEL FEEDTHROUGH PLATE BULKHEAD
 SEAL

QUANTITY OF LIKE ITEMS: 17
 SEVENTEEN

FUNCTION:
 A SINGLE SEAL AT EACH FEEDTHROUGH PLATE/BULKHEAD INTERFACE, IS PROVIDED AT SIX PLACES ON THE EXTERNAL AIRLOCK, TEN PLACES ON THE FORWARD ADAPTER ASSEMBLY, AND ONE PLACE ON THE FORWARD TUNNEL ASSEMBLY TO PREVENT LEAKAGE OF ODS PRESSURE AT THESE INTERFACES. FMEA ALSO INCLUDES SEALING CAPABILITIES OF DYNATUBE FITTINGS AND ELECTRICAL CONNECTOR FEEDTHRU'S LOCATED ON THESE FEEDTHROUGH PLATES.

REFERENCE DOCUMENTS: V828-342201
 V828-344101
 V828-344119
 V075-332421
 V075-332422

FAILURE MODES EFFECTS ANALYSIS FMEA - CIL FAILURE MODE

NUMBER: M8-1SS-M016-01

REVISION#: 1 04/08/97

SUBSYSTEM NAME: MECHANICAL - SEALS
 LRU: KIT, EXTERNAL AIRLOCK MISSION
 ITEM NAME: SEAL, FEEDTHROUGH PLATE

CRITICALITY OF THIS
 FAILURE MODE: 1R2

FAILURE MODE:
 LEAKAGE (O-RING SEAL)

MISSION PHASE: OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 103 DISCOVERY
 104 ATLANTIS
 105 ENDEAVOUR

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

REDUNDANCY SCREEN A) PASS
 B) PASS
 C) PASS

PASS/FAIL RATIONALE:

A)

B)

C)

METHOD OF FAULT DETECTION:
 INSTRUMENTATION/PHYSICAL OBSERVATION - REDUCED PRESSURE (CONSUMABLES)
 IN HABITABLE VOLUMES.

REMARKS/RECOMMENDATIONS:
 FEED THROUGH PLATE CONTAINS A SINGLE O-RING SEAL.

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- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF SEAL INTEGRITY AT ONE FEEDTHROUGH PLATE INTERFACE RESULTING IN LOSS OF ISOLATION BETWEEN EXT AIRLOCK/TUNNEL ASSY & OUTSIDE ATMOSPHERE.

(B) INTERFACING SUBSYSTEM(S):

REDUCED CONSUMABLES IN HABITABLE VOLUMES WITH 576 BULKHEAD HATCH AND EXTERNAL AIRLOCK UPPER HATCH OPEN. EXTERNAL LEAKAGE WOULD NOT EXCEED AIR MAKEUP CAPABILITY OF ORBITER ATMOSPHERIC REVITALIZATION PRESSURE CONTROL SYSTEM.

(C) MISSION:

POSSIBLE EARLY MISSION TERMINATION IF SECOND SEAL FAILURE OCCURS PRIOR TO DOCKING WITH SPACE STATION OR PRIOR TO COMPLETION OF IVA. LOSS OF CAPABILITY TO PERFORM PLANNED EVA.

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

NO EFFECT FIRST FAILURE. POSSIBLE LOSS OF CREW IF 2ND PLATE SEAL FAILURE OCCURS DURING IVA AND EXCESSIVE LEAKAGE CANNOT BE ISOLATED.

(E) FUNCTIONAL CRITICALITY EFFECTS:

FIRST FEEDTHROUGH PLATE SEAL FAILURE - GROSS LEAKAGE OF PRESSURE TO OUTSIDE ATMOSPHERE. IF FAILURE OCCURS WHEN ORBITER/SPACE STATION ARE DOCKED, POSSIBLE LOSS OF PRESSURE IN SPACE STATION WHEN EXTERNAL AIRLOCK UPPER HATCH IS OPEN.

SECOND FAILURE (ANOTHER SINGLE SEAL WITHIN HABITABLE VOLUME LEAKS): IF FAILURE OCCURS:

(2A) DURING DOCKED IVA ACTIVITIES EXCESSIVE LOSS OF CONSUMABLES CAN JEOPARDIZE CREW SAFETY.

(2B) DURING EVA, POSSIBLE LOSS OF EVA CREWMEMBERS IF ODS VOLUMES CANNOT BE REPRESSURIZED FOR RETURN TO CREW CABIN. (EVA CREWMEMBERS MUST REMAIN IN AIRLOCK UNTIL LANDING). - CRITICALITY 1R2 CONDITION.

(2C) DURING NON-DOCKED OPERATIONS, LOSS OF PRESSURE WITHIN ODS. LOSS OF SUBSEQUENT EVA CAPABILITIES IF ODS CANNOT BE REPRESSURIZED RESULTING IN LOSS OF MISSION OBJECTIVES ASSOCIATED WITH PLANNED EVA'S. - CRITICALITY 2R3 CONDITION.

DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 1R2

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

(3A) - THIRD FAILURE (INABILITY TO CLOSE 576 BULKHEAD HATCH) - FAILURE TO ISOLATE LEAKAGE FROM CREW CABIN RESULTING IN POTENTIAL LOSS OF CREW AND VEHICLE. - CRITICALITY 1R3 CONDITION

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(3C) - THIRD FAILURE (FAILURE NECESSITATING AN EVA TO PREVENT A POTENTIAL CATASTROPHIC SITUATION) - INABILITY TO PERFORM A CONTINGENCY EVA TO CORRECT A CRIT 1 CONDITION COULD RESULT IN LOSS OF CREW AND VEHICLE. - CRITICALITY 1R3 CONDITION.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: HOURS

TIME FROM FAILURE OCCURRENCE TO DETECTION: MINUTES

TIME FROM DETECTION TO COMPLETED CORRECTING ACTION: N/A

**IS TIME REQUIRED TO IMPLEMENT CORRECTING ACTION LESS THAN TIME TO EFFECT?
NO**

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:

THERE IS NO CORRECTIVE ACTION IF SECOND FAILURE OCCURS DURING AN EVA AND EXTERNAL AIRLOCK CANNOT BE REPRESSURIZED FOR EVA CREW'S RETURN TO CREW CABIN.

HAZARD REPORT NUMBER(S): ORBI 511, ORBI 405, FF-09

HAZARD(S) DESCRIPTION:

LOSS OF HABITABLE PRESSURE WHEN ORBITER AND SPACE STATION ARE NOT DOCKED (ORBI 511). EVA CREW HAZARDS DUE TO ISS ODS (ORBI 405). INABILITY TO SAFELY PERFORM EVA (FF-09).

-DISPOSITION RATIONALE-

(A) DESIGN:

SEALS ARE STANDARD O-RINGS USED AS FACE SEALS WITH PLATE ATTACH BOLTS ADJACENT TO SEAL. EACH SEAL PROVIDES INTERFACE SEALING BETWEEN FEEDTHROUGH PLATES AND EXTERNAL AIRLOCK/FWD ADAPTER/TUNNEL ASSY BULKHEAD. THERE ARE SIX FEEDTHROUGH PLATES ON EXTERNAL AIRLOCK, FIVE OF WHICH ACCOMMODATE AVIONICS/ELECTRICAL POWER AND RESOURCE TRANSFER. (THE REMAINING FEEDTHROUGH PLATE IS NOT UTILIZED.) THE TEN FEEDTHROUGH PLATES ON THE FWD ADAPTER AND ONE FEEDTHROUGH PLATE ON THE FWD TUNNEL CONTAIN ONLY ELECTRICAL CONNECTIONS. A SINGLE O-RING FACE SEAL IS INSTALLED IN A GROOVE IN EACH FEEDTHROUGH PLATE. SEAL MATERIAL, FLUOROCARBON ELASTOMER (VITON), IS RESISTANT TO FLUIDS. DIFFERENTIAL PRESSURE ACROSS BULKHEAD IS IN DIRECTION OF SEAL COMPRESSION.

(B) TEST:

QUALIFICATION/ACCEPTANCE TEST - THERE IS NO QTP/ATP FOR THE INDIVIDUAL FEEDTHROUGH PLATE SEAL. OVERALL PERFORMANCE OF THE EXTERNAL AIRLOCK/TUNNEL ASSEMBLY INCLUDES THE SEVENTEEN FEEDTHROUGH PLATE SEALS. IN-PROCESS AND ACCEPTANCE TESTS OF EXTERNAL AIRLOCK INCLUDES FIVE TESTS

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TO TEST THE INTEGRITY OF THE FEEDTHROUGH PLATES AND PENETRATIONS (DYNATUBE FITTINGS/ELECTRICAL CONNECTORS). THESE TESTS ARE ADDRESSED BELOW.

FEEDTHROUGH PLATE SEAL TESTING INCLUDES: LOW NEGATIVE PRESSURE TEST - EXTERNAL AIRLOCK IS PRESSURIZED TO 10.0 +/- 0.1 PSIG. ALLOWABLE LEAKAGE NOT TO EXCEED 1 BUBBLE PER MINUTE PER SEAL. DYNATUBE FITTING SEAL TESTING INCLUDES: (1) HIGH POSITIVE PRESSURE TEST - EXTERNAL AIRLOCK IS PRESSURIZED TO 900 +/- 50 PSIG. ALLOWABLE LEAKAGE NOT TO EXCEED 1×10^{-7} SCCS; AND (2) LOW POSITIVE PRESSURE TEST - EXTERNAL AIRLOCK IS PRESSURIZED TO 30 - 40 PSIG. ALLOWABLE LEAKAGE NOT TO EXCEED 1×10^{-7} SCCS.

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

(C) INSPECTION:

RECEIVING INSPECTION

RECEIVING INSPECTORS INSPECT FOR DAMAGE AND WORKMANSHIP AND VERIFY THAT IT IS OF SINGLE PIECE MOLDED CONSTRUCTION. RECEIVING INSPECTORS CHECK IDENTIFICATION AND WALL CROSS-SECTIONAL DIAMETER ON A 5-3 SAMPLING BASIS AND THAT SUPPLIER SUBMITTED REQUIRED REPORTS.

CONTAMINATION CONTROL

SEALS ARE VISUALLY INSPECTED FOR CLEANLINESS DURING RECEIVING INSPECTION.

ASSEMBLY/INSTALLATION

SEALS ARE INSTALLED PER MA0106-328. PRIOR TO INSTALLATION INSPECTION IS PERFORMED TO VERIFY SEALING SURFACES ARE NOT DAMAGED. THREADED FASTENERS ARE INSTALLED PER MA0101-301.

TESTING

ATP/IN-PROCESS/OMRSD TESTING VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING PROCEDURES AND REQUIREMENT FOR SHIPMENT VERIFIED BY INSPECTION.

(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:

THERE IS NO WORKAROUND TO A FAILURE TO RECOVER FROM AN EVA IF SECOND FAILURE OCCURS DURING THE EVA. HOWEVER, CREW COULD ISOLATE AN EXTERNAL LEAKAGE OF PRESSURE FOLLOWING SECOND FEEDTHROUGH PLATE SEAL FAILURE BY CLOSING THE APPROPRIATE HATCH(S).

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- APPROVALS -

SS & PAE	:	M. W. GUENTHER	:	<i>M. W. Guenther</i>
SS & PAE MANAGER	:	C. A. ALLISON	:	<i>C. A. Allison</i>
DESIGN ENGINEER	:	T. S. COOK	:	<i>T. S. Cook</i>
NASA SSMA	:		:	<i>Raymond J. Doughton</i>
NASA SUBSYSTEM MANAGER	:	with redlines, p3 & 4	:	<i>Raymond J. Doughton</i>
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