

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
 NUMBER:MR-1SS-M019 -X

SUBSYSTEM NAME: MECHANICAL - SEALS

REVISION: 1

04/08/97

 PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:HATCH LATCH ACTUATOR	MC287-0036-0069
SRU	:SEAL, LATCH ACTUATOR TO HATCH	MB3248/1-245

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
 EXTERNAL AIRLOCK AFT HATCH LATCH ACTUATOR TO HATCH STRUCTURE SEAL

QUANTITY OF LIKE ITEMS: 2
 TWO

FUNCTION:
 SEALS THE LATCH ACTUATOR TO THE EXTERNAL AIRLOCK AFT HATCH STRUCTURE
 TO PREVENT LEAKAGE THROUGH THIS INTERFACE.

NOTE: THE AFT HATCH IS REMOVED WHEN A PRESSURIZED PAYLOAD IS INSTALLED
 AND AS SUCH, ALL FAILURE MODES ASSOCIATED WITH THIS HATCH WOULD NOT
 APPLY.

REFERENCE DOCUMENTS: V519-331051
 M072-593830

**FAILURE MODES EFFECTS ANALYSIS FMEA - CIL FAILURE MODE
NUMBER: MB-1SS-M019-01**

REVISION#: 1 04/08/97

SUBSYSTEM NAME: MECHANICAL - SEALS
LRU: SEAL, LATCH ACTUATOR TO HATCH STRUCTURE
ITEM NAME: O-RING SEALS

CRITICALITY OF THIS
FAILURE MODE: 1R3

FAILURE MODE:
LEAKAGE

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) FAIL
- B) N/A
- C) PASS

PASS/FAIL RATIONALE:

A)
FAILS SCREEN 'A' BECAUSE A LEAK TEST OF EACH (INDIVIDUAL) SEAL IS NOT POSSIBLE
DURING GROUND CHECKOUT.

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

C)

METHOD OF FAULT DETECTION:

NONE FOR FIRST FAILURE. FAILURE OF REDUNDANT O-RING SEAL CAN BE DETECTED
THROUGH INSTRUMENTATION & PHYSICAL OBSERVATION - LOSS OF ODS PRESSURE.

REMARKS/RECOMMENDATIONS:

THIS FAILURE MODE APPLIES TO THE EXTERNAL AIRLOCK AFT HATCH WHILE IT IS
CLOSED AND WHEN THERE IS NO PRESSURIZED PAYLOAD INSTALLED IN THE PAYLOAD
BAY.

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- FAILURE EFFECTS -

(A) SUBSYSTEM:

NO EFFECT FIRST FAILURE. SECOND O-RING FAILURE WILL RESULT IN THE INABILITY TO ISOLATE THE EXTERNAL AIRLOCK FROM OUTSIDE ATMOSPHERE.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT FIRST FAILURE. LOSS OF PRESSURE TO OUTSIDE ATMOSPHERE AND INCREASED USE OF O2/N2 CONSUMABLES GIVEN A SIMILAR FAILURE OF SECOND O-RING.

(C) MISSION:

NO EFFECT FIRST O-RING FAILURE. WORST CASE IF SECOND O-RING FAILURE OCCURS PRIOR TO DOCKING - CREW DECISION TO ABORT MISSION DUE TO LOSS OF CONSUMABLES. INABILITY TO PERFORM PLANNED EVA FOLLOWING SECOND O-RING FAILURE.

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

NO EFFECT FIRST FAILURE UNTIL LOSS OF REDUNDANT SEAL AND AN ADDITIONAL SEAL FAILS WITHIN HABITABLE VOLUME AND LEAK RATE EXCEEDS MAKEUP CAPABILITY OF ATMOSPHERIC REVITALIZATION PRESSURE CONTROL SYSTEM (ARPCS). THEN POSSIBLE LOSS OF CREW AND VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

FIRST O-RING FAILURE - NO EFFECT, LOSS OF REDUNDANCY ONLY.

SECOND O-RING FAILURE - POSSIBLE EARLY MISSION TERMINATION DUE TO LEAKAGE TO OUTSIDE ATMOSPHERE RESULTING IN AN INCREASED USE OF CONSUMABLES. IF SECOND FAILURE OCCURS WHEN ORBITER/SPACE STATION ARE DOCKED, POSSIBLE LOSS OF PRESSURE IN SPACE STATION WHEN EXTERNAL AIRLOCK UPPER HATCH IS OPEN.

THIRD FAILURE (ADDITIONAL SINGLE SEAL FAILURE WITHIN HABITABLE VOLUME). IF FAILURE OCCURS:

(3A) DURING DOCKED IVA ACTIVITIES EXCESSIVE LOSS OF CONSUMABLES CAN JEOPARDIZE CREW SAFETY.

(3B) 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 1R3 CONDITION.

(3C) DURING NON-DOCKED OPERATIONS, LOSS OF PRESSURE WITHIN EXTERNAL AIRLOCK. LOSS OF SUBSEQUENT EVA CAPABILITIES IF EXTERNAL AIRLOCK CANNOT BE REPRESSURIZED RESULTING IN LOSS OF MISSION OBJECTIVES ASSOCIATED WITH PLANNED EVA'S. - CRITICALITY 2R3 CONDITION.

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

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

(4A) - FOURTH FAILURE (INABILITY TO CLOSE 576 BULKHEAD HATCH) - FAILURE TO ISOLATE LEAKAGE FROM CREW CABIN RESULTING IN POTENTIAL LOSS OF CREW AND VEHICLE.

(4C) - FOURTH 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.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: DAYS

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 THIRD 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:

ACTUATOR MOUNTING FLANGE IS INSTALLED ON HATCH BASE STRUCTURE WITH 12 ATTACH BOLTS. DUAL CONCENTRIC O-RING FACE SEALS IN ACTUATOR FLANGE GROOVES ARE ADJACENT TO ATTACH BOLTS. O-RINGS ARE LUBRICATED WITH MB0140-010 TYPE II GREASE PER MA0112-303. EITHER O-RING CAN PREVENT LEAKAGE THROUGH HATCH. FLANGE TO HATCH INTERFACE IS METAL TO METAL CONTACT. SEAL MATERIAL IS FLUOROCARBON ELASTOMER (VITON).

(B) TEST:

ACCEPTANCE TESTS: STRUCTURAL LEAK TEST TO 14.7 PSID IS PERFORMED.

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QUALIFICATION TESTS: NO QUALIFICATION TESTS WERE PERFORMED ON THE INDIVIDUAL SEAL. CERTIFICATION IS BASED ON ACCEPTANCE TESTS AND SEAL MATERIALS DATA. QUALIFICATION TESTS OF ACTUATOR INCLUDED LIMIT LOAD TEST (10 CYCLES), 2000 OPERATING CYCLES AT 30 INCH-LB INPUT TORQUE, THERMAL CYCLING BETWEEN -65 DEG F AND +250 DEG F.

IN-PROCESS AND ACCEPTANCE TEST (HATCH) - STRUCTURAL PROOF PRESSURE TEST PERFORMED IN BOTH DIRECTIONS IN ACCORDANCE WITH PARAGRAPH 4.01.01.01.05 OF MLD101-0104-001. USING AIR OR GN2 PER MF0004-039 HATCH IS PRESSURIZED TO 17.6 +0.1/-0 PSIG AND HELD FOR A MINIMUM OF 5 MINUTES.

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

(C) INSPECTION:

RECEIVING INSPECTION

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

CONTAMINATION CONTROL

RECEIVING INSPECTORS VISUALLY INSPECT SEAL FOR CLEANLINESS. INSPECTORS VERIFY CLEANLINESS OF SEALING SURFACE & VITON SEAL PRIOR TO INSTALLATION.

ASSEMBLY/INSTALLATION

THE SEALS ARE INSTALLED PER MA0106-328. PRIOR TO INSTALLATION AN INSPECTION IS PERFORMED TO VERIFY THAT THE SEALING SURFACE IS NOT DAMAGED. INSPECTION VERIFIES MB0140-010 TYPE II GREASE WAS APPLIED TO O-RINGS AND O-RING GROOVES PRIOR TO ASSEMBLY PER MA0112-303. INSPECTION VERIFIES DIMENSIONS OF DETAIL PARTS.

TESTING

TESTING VERIFIED BY INSPECTION.

HANDLING/PACKAGING

THE RECEIVING INSPECTORS VERIFY THAT THE SEAL IS INDIVIDUALLY PACKAGED WITH PART NUMBER, MANUFACTURER NAME, COMPOUND NUMBER AND CURE DATE. RECEIVING INSPECTORS ALSO VERIFY THAT THE SEAL IS PACKAGED IN A WAY THAT WILL PROTECT IT DURING STORAGE.

(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 FIRST O-RING SEAL FAILURE. IF BOTH SEALS FAIL ON EXTERNAL AIRLOCK AFT HATCH ACTUATOR MOUNTING STRUCTURE, ORBITER ARPCS WOULD PROVIDE AIR

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MAKEUP CAPABILITIES. IF AN ADDITIONAL SEAL WITHIN HABITABLE VOLUME FAILS
CREW COULD ISOLATE LEAKAGE BY CLOSING THE APPROPRIATE HATCH(S).

- 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>Benjamin C. Benvenuti</i>
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JSC MOD	:		:	<i>[Signature]</i>