

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
 NUMBER:M8-1SS-M018 -X

SUBSYSTEM NAME: MECHANICAL - SEALS

REVISION: 1

04/08/97

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
-LRU	:HATCH LATCH ACTUATOR	MC287-0036-0008
SRU	:SEAL, LATCH ACTUATOR TO HATCH	M83248/1-245

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

QUANTITY OF LIKE ITEMS: 2
 TWO

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

REFERENCE DOCUMENTS: V519-331051
 V519-593302
 M072-593828

FAILURE MODES EFFECTS ANALYSIS FMEA - CIL FAILURE MODE

NUMBER: M8-155-M018-01

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 REDUNDANCY SCREEN 'A' BECAUSE THE SEALS CANNOT BE VERIFIED
INDIVIDUALLY 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
WHEN ORBITER AND SPACE STATION ARE NOT DOCKED.

REMARKS/RECOMMENDATIONS:

THIS FAILURE MODE APPLIES TO THE EXTERNAL AIRLOCK UPPER HATCH WHILE IT IS
CLOSED AND THE ORBITER/SPACE STATION ARE NOT DOCKED.

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- FAILURE EFFECTS -

(A) SUBSYSTEM:

NO EFFECT FIRST FAILURE. SECOND O-RING FAILURE WILL RESULT IN THE INABILITY TO ISOLATE THE VESTIBULE TUNNEL FROM EXTERNAL AIRLOCK ENVIRONMENT. NO EFFECT DURING IVA SINCE EXTERNAL AIRLOCK UPPER HATCH IS OPEN.

(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 WHEN ORBITER AND SPACE STATION ARE NOT DOCKED. INABILITY TO DEPRESSURIZE VESTIBULE TUNNEL FOR SEPARATION WITHOUT EFFECTING THE ODS VOLUMES.

(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. NO EFFECT DURING IVA SINCE EXTERNAL AIRLOCK UPPER HATCH IS OPEN.

(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).

(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 WHEN ORBITER/SPACE STATION ARE NOT DOCKED RESULTING IN AN INCREASED USE OF CONSUMABLES. - CRITICALITY 2R3 CONDITION. IF SECOND FAILURE OCCURS WHEN ORBITER/SPACE STATION ARE DOCKED, POSSIBLE LOSS OF PRESSURE IN SPACE STATION IF ISOLATION BETWEEN EXTERNAL AIRLOCK AND SPACE STATION IS LOST DURING EVA WHEN ODS IS DEPRESSURIZED.

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

(3A) DURING IVA (CAMERA PREPARATION FOR DOCKING) 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 ODS. LOSS OF SUBSEQUENT EVA CAPABILITIES IF ODS CANNOT BE REPRESSURIZED.

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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 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.

QUALIFICATION TESTS: NO QUALIFICATION TESTS WERE PERFORMED ON THE INDIVIDUAL SEAL. CERTIFICATION IS BASED ON ACCEPTANCE TESTS AND SEAL

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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) - (1) STRUCTURAL PROOF PRESSURE TEST PERFORMED IN BOTH DIRECTIONS IN ACCORDANCE WITH PARAGRAPH 4.01.01.01.05 OF ML0101-0104-001: 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. (2) UPPER BULKHEAD HATCH LEAK TEST PERFORMED IN ACCORDANCE WITH PARAGRAPH 4.01.01.02.02.06 OF ML0101-0104-001: HATCH PRESSURIZED TO 15.0 +/-1 PSIG FOR A PERIOD OF 60 SECONDS. LEAK RATE VERIFIED NOT TO EXCEED 1 PSIG MAXIMUM.

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 S-3 SAMPLING BASIS AND THAT SUPPLIER SUBMITTED REQUIRED REPORTS.

CONTAMINATION CONTROL

RECEIVING INSPECTORS VISUALLY INSPECT SEAL FOR CLEANLINESS. INSPECTORS VERIFY, BEFORE INSTALLATION, THAT THE SEALING SURFACE AND VITON SEAL ARE CLEAN.

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.

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(E) OPERATIONAL USE:

NONE FOR FIRST O-RING SEAL FAILURE. IF BOTH SEALS FAIL ON EXTERNAL AIRLOCK UPPER HATCH ACTUATOR MOUNTING STRUCTURE PRIOR TO OR FOLLOWING MATING WITH THE SPACE STATION, GIVEN SUFFICIENT TIME, CREW COULD ISOLATE LEAKAGE BY CLOSING 576 BULKHEAD HATCH.

- APPROVALS -

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