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PRINT DATE: 08/16/95

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE**

**NUMBER: M8-1MR-M003-X**

**SUBSYSTEM NAME: MECHANICAL - EXTERNAL AIRLOCK**

**REVISION: 3 9/15/95**

	<b>PART NAME VENDOR NAME</b>	<b>PART NUMBER VENDOR NUMBER</b>
LRU	ACTUATOR, HATCH LATCH	MC287-0036-0009

**PART DATA**

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
EXTERNAL AIRLOCK UPPER HATCH LATCH ACTUATOR**

**REFERENCE DESIGNATORS:**

**QUANTITY OF LIKE ITEMS: 1  
ONE**

**FUNCTION:**

MANUALLY DRIVEN REDUCTION GEARBOX - PROVIDES A CONTROLLED OUTPUT FOR DRIVING THE LATCH MECHANISM ON EXTERNAL AIRLOCK UPPER HATCH OPEN OR CLOSED. PROVIDES THE FORCE FOR HATCH SEAL COMPRESSION AS IT PULLS THE SEALING SURFACES TOGETHER. TWO HANDLES FOR OPERATION ARE PROVIDED FOR THE HATCH; ONE IS ON EACH SIDE OF THE HATCH. A MECHANICAL LOCK AND A "NO-BACK" ARE PROVIDED FOR RESTRAINT BETWEEN USES. THE KNOB ON THE HANDLE ON THE VESTIBULE SIDE OF THE HATCH IS REMOVABLE. THE DESIGN UTILIZES DUAL O-RING SEALS TO PREVENT LEAKAGE OF OOS ATMOSPHERE THROUGH OR PAST THE ACTUATORS.

**REFERENCE DOCUMENTS: M072-593829**

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**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE**

NUMBER: M8-1MR-M003-02

REVISION# 3 9/15/95

SUBSYSTEM NAME: MECHANICAL - EXTERNAL AIRLOCK

LRU: ACTUATOR, HATCH LATCH

ITEM NAME: O-RING SEALS

CRITICALITY OF THIS

FAILURE MODE: 2R3

**FAILURE MODE:**

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

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 REDUNDANCY SCREEN "A" BECAUSE THE SEALS CANNOT BE VERIFIED  
INDIVIDUALLY DURING GROUND CHECKOUT.

B)

N/A - AT LEAST ONE REMAINING PATH IS 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 CONSUMABLES IN  
ODS VOLUME.**- 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 OPERATIONS SINCE EXTERNAL AIRLOCK UPPER HATCH IS OPEN.



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FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE  
NUMBER: M8-1MR-M003-02

HAZARD(S) DESCRIPTION:  
N/A

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-DISPOSITION RATIONALE-

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(A) DESIGN:

SEALS ARE STANDARD TYPE DUAL O-RING SEALS HELD IN SEPARATE GROOVES AGAINST A ROTATING INPUT SHAFT (LIMITED TO +450 DEG) OR AGAINST A SLIDING LOCKING STEM (LIMITED TO LESS THAN 3/8 INCH STROKE). DESIGNED FOR REPEATED USE - 2,000 CYCLES; EACH ROTATIONAL CYCLE OF THE INPUT SHAFT INCLUDES ONE FULL CLOCKWISE AND ONE FULL COUNTERCLOCKWISE ROTATION WITH A NORMAL 30 LB LOAD AT THE HANDLE (EQUIVALENT TO 10 YEAR, 100 MISSION LIFE) - WITHOUT SCHEDULED SERVICING OR MAINTENANCE. EACH SLIDING CYCLE OF THE LOCKING STEM INCLUDES ONE FULL UNLOCKING AND ONE FULL LOCKING ACTION OF THE FLIP-OVER LOCKING LEVER.

(B) TEST:

QUALIFICATION TESTS: SEALS QUALIFIED AS PART OF COMPONENT QUALIFICATION TESTING OF MC287-0036-0004 AND -0006 LATCH ACTUATOR PER CA-28-287-0036-0006C. QUALIFICATION TESTS INCLUDE: LIMIT LOAD TEST (10 CYCLES, WITH 3,750-4,941 LB AT OUTPUT ARM AND 150 LB AT HANDLE), CABIN ATMOSPHERE TEST (INCLUDES SALT FOG FOR 1 HOUR, +80 DEGREES F AND +120 DEGREES F AT 80% RELATIVE HUMIDITY FOR 120 HOURS), RANDOM VIBRATION TESTING FOR 48 MINUTES IN EACH OF THREE ORTHOGONAL AXES, SHOCK TEST (+/- 20 G'S, 11 MILLISECONDS EACH SHOCK, 110 TOTAL; PER MIL-STD-810), NORMAL OUTPUT TEST (2,000 CYCLES WITH 30 LB LOAD AT THE HANDLE; NOMINAL 6 CYCLES PER MISSION AND GROUND TURNAROUND; 600 CYCLES PER 100-MISSION LIFE), THERMAL CYCLE TEST BETWEEN -65 DEG F AND +275 DEG F (5 COMPLETE CYCLES AT EACH EXTREME TEMPERATURE - WITH A MINIMUM TEMPERATURE SOAK OF 60 MINUTES) AND ACCELERATION TEST (+/- 5 G'S IN EACH OF THREE ORTHOGONAL AXES, 5 MINUTES IN EACH AXIS).

ACCEPTANCE TESTS: ACCEPTANCE TESTING INCLUDES 100% EXAMINATION, 100% X-RAY, 100% LEAKAGE TESTING (NOT TO EXCEED 0.00001 STD CC/SEC/INCH OF SEAL AT 16 PSI LIMIT DELTA P) AND 100% NORMAL LOAD TEST (10 CYCLES, WITH 30 LB AT HANDLE AND 775-988 LB ON OUTPUT ARM).

OPERATIONS. TESTS ARE PERFORMED WHEN THE EXTERNAL AIRLOCK IS INSTALLED ON THE VEHICLE. NO OMRSD TEST CAPABLE OF DETECTING FIRST FAILURE OF SEAL MAINTENANCE SAMPLING ON ACTUATOR AND SEALS AFTER FIRST 36 FLIGHTS/8 YEARS AND THEN AFTER NEXT 12 FLIGHTS/2 YEARS.

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

(C) INSPECTION:

RECEIVING INSPECTION

RAW MATERIAL VERIFIED VISUAL INSPECTION/IDENTIFICATION PERFORMED. PARTS PROTECTION VERIFIED. O-RINGS ARE MAGNIFICATION INSPECTED FOR DAMAGE.

CONTAMINATION CONTROL

CONTAMINATION CONTROL PROCESSES AND CORROSION PROTECTION PROVISIONS VERIFIED. ALL PARTS ARE CLEANED TO 300 LEVEL PRIOR TO ASSEMBLY AND VERIFIED BY INSPECTION:

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FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE  
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ASSEMBLY/INSTALLATION

RAW MATERIAL VERIFIED, VISUAL INSPECTION/IDENTIFICATION PERFORMED, PARTS PROTECTION VERIFIED, MANUFACTURING, INSTALLATION AND ASSEMBLY OPERATIONS VERIFIED BY SHOP TRAVELER MANDATORY INSPECTION POINTS (MIPS). O-RINGS ARE MAGNIFICATION INSPECTED AT RECEIVING AND INSTALLATION.

NONDESTRUCTIVE EVALUATION

STRUCTURAL INTEGRITY VERIFIED BY NONDESTRUCTIVE EVALUATION (NDE) (X-RAY) AND TECHNICIANS CERTIFICATIONS ARE VERIFIED BY INSPECTION.

TESTING

TESTING VERIFIED BY INSPECTION

HANDLING/PACKAGING

PROPERLY MONITORED HANDLING AND STORAGE ENVIRONMENT VERIFIED.

(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:

AMOUNT OF LEAKAGE, GIVEN A FAILURE OF BOTH SEALS, IS LOW ENOUGH TO ALLOW THE CREW TO CLOSE APPROPRIATE HATCH(S) TO ISOLATE LEAKAGE FROM CREW CABIN.

- APPROVALS -

PRODUCT ASSURANCE ENGR	: M. W. GUENTHER
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