

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

**NUMBER: M8-1SS-BM032-X**  
**(APPLIES ONLY TO THE PMA 2/3)**

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 0 DEC, 1995

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: HATCH ASSEMBLY RSC-ENERGIA	33U.4371.016-02 33U.4371.016-02
SRU	: LATCH ACTUATOR RSC-ENERGIA	33U.3431.001 33U.3431.001

**PART DATA**

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
**LATCH ACTUATOR ASSEMBLY**

REFERENCE DESIGNATORS:

**QUANTITY OF LIKE ITEMS: 1**  
**ONE**

**FUNCTION:**

MANUALLY-OPERATED LATCH ACTUATOR IS DESIGNED TO OPEN/CLOSE EIGHT TIGHTENING ELEMENTS AND SIMULTANEOUSLY CARRY OUT THE HATCH SEALING/UNSEALING. THERE ARE RECESSES ON BOTH SIDES OF THE HATCH TO ACCEPT A CRANK HANDLE. IT IS REQUIRED TO COMPLETE THREE AND A HALF REVOLUTIONS TO OPEN/CLOSE THE HATCH. DUAL INTERNAL SEALS PROVIDE A REDUNDANT MEANS OF PREVENTING LEAKAGE THROUGH THE ACTUATOR. DUAL MOUNTING SEALS PROVIDE A REDUNDANT MEANS OF PREVENTING LEAKAGE AROUND THE ACTUATOR.

**MAINTAINABILITY**

REPAIR METHOD -NONE (REPAIRING IN MANUFACTURING CONDITIONS ONLY).

**REFERENCE DOCUMENTS:** 33U.4371.016  
 33U.4371.016-02

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NUMBER: M8-1SS-BM032- 01  
(APPLIES ONLY TO THE PMA 2/3)

REVISION# 1 JAN, 1997

SUBSYSTEM NAME: MECHANICAL - EDS

LRU: HATCH ASSEMBLY

ITEM NAME: LATCH ACTUATOR

CRITICALITY OF THIS

FAILURE MODE: 2/2

**FAILURE MODE:**

PHYSICAL BINDING/JAMMING

**MISSION PHASE:**

OO ON-ORBIT

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

**CAUSE:**

ADVERSE TOLERANCES/WEAR, CONTAMINATION/FOREIGN OBJECT/DEBRIS, FAILURE/  
DEFLECTION OF INTERNAL PART

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? N/A

**REDUNDANCY SCREEN**

A) N/A  
B) N/A  
C) N/A

**PASS/FAIL RATIONALE:**

A)  
N/A

B)  
N/A

C)  
N/A

**METHOD OF FAULT DETECTION:**

VISUAL OBSERVATION (THE CRANK HANDLE DOES NOT ROTATE).

**REMARKS/RECOMMENDATIONS:**

THE HATCH IS CLOSED AND SEALED ON THE GROUND AND OPENED ONLY ONCE DURING THE INITIAL DOCKING (MISSION 2A) AND LEFT UNSEALED FOR SUBSEQUENT MISSIONS. EVEN WITH THE HATCH CLOSED, PMA 2/3 WOULD BE EXPOSED TO A VACUUM, AFTER SEPARATION, SINCE THE PASSIVE MECHANISM HATCH EQUALIZATION VALVE IS LEFT OPEN FOLLOWING ITS INITIAL OPENING FOR FLIGHT 2A.

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**- FAILURE EFFECTS -**

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**(A) SUBSYSTEM:**

A JAMMED ACTUATOR WOULD PREVENT THE TIGHTENING ELEMENTS FROM OPERATING. INABILITY TO OPEN THE PASSIVE MECHANISM HATCH WOULD PREVENT ORBITER ACCESS TO STATION.

**(B) INTERFACING SUBSYSTEM(S):**

NO EFFECT ON ORBITER INTERFACING SUBSYSTEMS DURING HATCH OPENING. INABILITY TO CLOSE PASSIVE MECHANISM HATCH WOULD EXPOSE PMA 2 OR PMA 3 TO POTENTIAL CONTAMINATION FOLLOWING ORBITER/ISS SEPARATION. POTENTIAL FOR TARGET BEING MISALIGNED IF HATCH CANNOT BE FULLY CLOSED.

**(C) MISSION:**

LOSS OF PRIMARY MISSION OBJECTIVES IF HATCH CANNOT BE OPENED DUE TO INABILITY TO ACCESS THE SPACE STATION THROUGH VESTIBULE TUNNEL. SUBSEQUENT DOCKINGS MAY BE AFFECTED IF TARGET IS MISALIGNED.

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

NO EFFECT ON CREW OR VEHICLE.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

N/A

**DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): N/A**

**(F) RATIONALE FOR CRITICALITY DOWNGRADE:**

WORST CASE. THERE IS NO WORKAROUND TO CIRCUMVENT AN ACTUATOR FAILURE THAT PREVENTS OPENING OR CLOSING OF THE HATCH.

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**- TIME FRAME -**

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**TIME FROM FAILURE TO CRITICAL EFFECT: MINUTES**

**TIME FROM FAILURE OCCURRENCE TO DETECTION: IMMEDIATE**

**TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: N/A**

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

**RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:**

THERE IS NO CORRECTIVE ACTION FOR THE INITIAL ISS FLIGHTS SINCE THERE IS NO ONE OCCUPYING THE SPACE STATION.

**HAZARDS REPORT NUMBER(S): NONE**

**HAZARD(S) DESCRIPTION:**

N/A

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

THE LATCH DRIVE ACTUATOR IS DESIGNED TO MANUALLY OPEN AND CLOSE EIGHT TIGHTENING ELEMENTS AND SIMULTANEOUSLY CARRY OUT THE HATCH SEALING/UNSEALING. THERE ARE HOLES ON BOTH SIDES OF THE HATCH ACTUATOR TO ACCEPT A CRANK HANDLE. IT IS REQUIRED TO COMPLETE THREE AND A HALF REVOLUTIONS TO OPEN/CLOSE THE HATCH. THE OUTPUT TORQUE MOMENT IS LESS THAN 0.5 KGM. THE ACTUATOR CONTAINS TWO O-RING SEALS TO PREVENT INTERNAL CONTAMINATION AND TO PREVENT THE EFFECTS OF HARD VACUUM EXPOSURE TO THE GEARS, BEARINGS, SHAFTS AND THE "NO-BACK". DUAL MOUNTING SEALS PREVENT LEAKAGE OF PMA ATMOSPHERE AROUND THE ACTUATOR. POSITIVE MARGINS ON ALL COMPONENTS.

**(B) TEST:**

REFER TO "APPENDIX B" FOR DETAILS OF THE FOLLOWING ACCEPTANCE AND QUALIFICATION TESTS OF THE DOCKING MECHANISMS RELATIVE TO THIS FAILURE MODE.

**DOCKING MECHANISM ACCEPTANCE TESTS:**

1. HATCH FUNCTION TEST
2. HATCH AND APDA BODY COMPONENT PROOF PRESSURE TEST
3. VIBRATION TEST AVT (RANDOM VIBRATION 360SEC (120SEC PER AXIS))

**DOCKING MECHANISM QUALIFICATION TESTS:**

1. HATCH TEST (ACCORDING TO THE QUAL TEST PROGRAMM)
2. PARTIALLY DISASSEMBLY INSPECTION

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

**(C) INSPECTION:**

REPEATED INSPECTIONS FOR THE HATCH ELEMENTS WITHIN DOCKING MECHANISM ARE CARRY OUT DURING ASSEMBLY AND ACCEPTANCE TESTS.

**RECEIVING INSPECTION**

COMPONENTS ARE SUBJECTED TO A 100% RECEIVING INSPECTION PRIOR TO INSTALLATION.

**CONTAMINATION CONTROL**

CORROSION PROTECTION PROVISIONS AND CONTAMINATION CONTROL VERIFIED BY INSPECTION. CHECK OF ROOM CLEANLINESS; PARTS WASHING AND OTHER OPERATIONS OF THE TECHNOLOGICAL PROCESS WHICH PROVIDES CLEANLINESS ARE VERIFIED BY INSPECTION.

**CRITICAL PROCESSES**

ANODIZING, HEAT TREATING, CHEMICAL PLATING, AND CURING VERIFIED BY INSPECTION.

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**ASSEMBLY/INSTALLATION**  
TORQUE, ADJUSTMENTS AND TOLERANCES ACCORDING TO TECHNICAL REQUIREMENTS OF THE DRAWINGS ARE VERIFIED BY INSPECTION.

**TESTING**  
ATP/QTP TESTING VERIFIED BY INSPECTION.

**HANDLING/PACKAGING**  
HANDLING/PACKAGING PROCEDURES AND REQUIREMENT FOR SHIPMENT VERIFIED BY INSPECTION.

**(D) FAILURE HISTORY:**  
DATA ON TEST FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING OF ODS DOCKING MECHANISMS CAN BE FOUND IN PRACA DATA BASE.

**(E) OPERATIONAL USE:**  
**DURING HATCH OPENING:**  
WHEN ISS IS NON-INHABITED NO OPERATIONAL WORKAROUND IS POSSIBLE BECAUSE TIGHTENING ELEMENTS ARE ON THE INSIDE OF HATCH AND ARE INACCESSIBLE TO ORBITER CREW MEMBERS IN EXTERNAL AIRLOCK. WHEN ISS IS HABITED AND HATCH IS CLOSED, SPACE STATION CREW COULD REMOVE EACH OF THE EIGHT LATCH RESTRAINING BRACKETS OVER THE EIGHT TIGHTENING ELEMENTS BY REMOVING THEIR THREE BOLTS.  
**DURING HATCH CLOSING:**  
PRESSURIZING AFFECTED PMA, FOLLOWING CLOSING OF THE EQUALIZATION VALVE, WILL PROVIDE THE NECESSARY DELTA-PRESSURE FORCE TO KEEP THE HATCH CLOSED AND SEALED.

**- APPROVALS -**

PRODUCT ASSURANCE ENGR : M. NIKOLAYEVA  
DESIGN ENGINEER : E. BOBROV  
DESIGN ENGINEER : L. PROLOV  
NASA SSMA :  
NASA SUBSYSTEM MANAGER :  
JSC MOD :

*[Handwritten signatures and initials over horizontal lines]*