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PRINT DATE: 02/18/95

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE**  
NUMBER: M8-1MR-M002-X

SUBSYSTEM NAME: MECHANICAL - EXTERNAL AIRLOCK  
REVISION: 3 8/15/95

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: MECHANISM. LATCH	V519-593302

**PART DATA**

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
EXTERNAL AIRLOCK AFT HATCH LATCH MECHANISM

**REFERENCE DESIGNATORS:**

**QUANTITY OF LIKE ITEMS: 1**  
ONE

**FUNCTION:**

THIS MECHANISM IS MOUNTED ON THE SPACELAB SIDE (MIR 1) OR PAYLOAD BAY SIDE (MULTI-MIR) OF EXTERNAL AIRLOCK AFT HATCH TO SECURE IT IN THE CLOSED AND SEALED POSITION. THIS ASSEMBLY CONSISTS OF SEVENTEEN (17) HATCH-TYPE LATCHES WHICH ARE JOINED BY RODS AND LINKS. THE RODS AND LINKS MOVE CIRCUMFERENTIALLY, CAUSING THE LATCHES TO MOVE AXIALLY TO SECURE THE LATCHES IN A CLOSED AND SEALED POSITION. TWO "KICKER" LATCHES INCORPORATE PROVISION FOR "BREAKING FREE" THE HATCH SEALS AGAINST ANY SMALL RESIDUAL DELTA PRESSURE. WHEN OPENING THE HATCH, THE LATCHES ARE DRIVEN BY A MANUALLY OPERATED REDUCTION GEARBOX (ACTUATOR).

**REFERENCE DOCUMENTS: M072-593829**

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

NUMBER: M8-1MR-M002-02

REVISION# 3 9/15/95

SUBSYSTEM NAME: MECHANICAL - EXTERNAL AIRLOCK

LRU: MECHANISM, LATCH

CRITICALITY OF THIS

ITEM NAME: MECHANISM, LATCH

FAILURE MODE: 2/2

**FAILURE MODE:**

FAILS TO DISENGAGE

**MISSION PHASE:**

OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 104 ATLANTIS

**CAUSE:**ADVERSE TOLERANCES/WEAR, CONTAMINATION/FOREIGN OBJECT/DEBRIS, FAILURE/  
DEFLECTION OF INTERNAL PART, PHYSICAL BINDING/JAMMING

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/AB)  
N/AC)  
N/A**METHOD OF FAULT DETECTION:**EXTERNAL AIRLOCK AFT HATCH LATCH MECHANISM FAILING TO DISENGAGE CAN BE  
VISUALLY/PHYSICALLY DETECTED BY THE FLIGHT CREW.**REMARKS/RECOMMENDATIONS:**EXTERNAL AIRLOCK AFT HATCH CAN BE UTILIZED FOR EVA PURPOSES. ALTHOUGH  
TUNNEL ADAPTER 'C' HATCH IS THE PRIMARY HATCH FOR PERFORMING AN EVA.  
CRITICALITY OF THIS FAILURE MODE (2/2) ADDRESSES THE WORST CASE SENARIO OF  
HAVING A PRESSURIZED PAYLOAD. WHERE AS THE CRITICALITY OF THIS FAILURE  
MODE WITHOUT A PRESSURIZED PAYLOAD IS A 1R3.

- FAILURE EFFECTS -

**(A) SUBSYSTEM:**

EXTERNAL AIRLOCK AFT HATCH CANNOT BE OPENED.

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**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE  
NUMBER: M8-1MR-M002-02****(B) INTERFACING SUBSYSTEM(S):**

LOSS OF CAPABILITY TO ENTER SPACELAB FOR MIR 1 OR LOSS OF CAPABILITY TO SUPPORT EVA THROUGH EXTERNAL AIRLOCK AFT HATCH IF HATCH CANNOT BE UNLATCHED AND OPENED (PRE-EVA) FOR MIR 2.

**(C) MISSION:**

MIR 1 - INABILITY TO ENTER SPACELAB WOULD LOSE MISSION OBJECTIVES ASSOCIATED WITH SPACELAB.  
MULTI-MIR - NO EFFECT ON IVA MISSION OBJECTIVES SINCE MISSION IS ACCOMPLISHED WITH EXTERNAL AIRLOCK AFT HATCH CLOSED. INABILITY TO PERFORM PLANNED EVA IF SIMILAR FAILURE OCCURS ON EVA "C" HATCH.

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

MIR 1 - NO EFFECT ON CREW/VEHICLE.  
MULTI-MIR - POSSIBLE LOSS OF CREW/VEHICLE ONLY IF CONTINGENCY EVA IS REQUIRED AND BOTH EVA "C" HATCH AND EXTERNAL AIRLOCK AFT HATCH CANNOT BE UNLATCHED AND OPENED.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

FIRST FAILURE (EXTERNAL AIRLOCK AFT HATCH LATCH MECHANISM FAILS TO DISENGAGE) - EXTERNAL AIRLOCK AFT HATCH CANNOT BE OPENED. INABILITY TO ENTER SPACELAB WOULD LOSE MISSION OBJECTIVES ASSOCIATED WITH SPACELAB - CRIT 2/2 CONDITION FOR MIR 1 ONLY. NO EFFECT FOR MULTI-MIR OTHER THAN THE INABILITY TO PERFORM AN EVA OUT EXTERNAL AIRLOCK AFT HATCH.  
MULTI-MIR ONLY: SECOND FAILURE (EVA "C" HATCH LATCH MECHANISM FAILS TO DISENGAGE) - LOSS OF CONTINGENCY EVA CAPABILITIES TO CORRECT A CRIT 1 CONDITION COULD RESULT IN LOSS OF CREW AND VEHICLE. - CRIT 1R3 CONDITION.

**DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 2/2****(F) RATIONALE FOR CRITICALITY DOWNGRADE:**

N/A (THERE ARE NO WORKAROUNDS TO CIRCUMVENT THIS FAILURE).

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**- TIME FRAME -**

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**TIME FROM FAILURE TO CRITICAL EFFECT: MINUTES****TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS****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 TO RESTORE THE AFT HATCH LATCH MECHANISM THAT FAILS TO DISENGAGE SINCE LATCH MECHANISM IS ON PAYLOAD BAY SIDE OF HATCH AND IS INACCESSIBLE TO ORBITER CREW MEMBERS IN EXTERNAL AIRLOCK.

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

N/A

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FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE

NUMBER: M8-1MR-MD02-02

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

LATCH MECHANISM BASED ON PROVEN APOLLO DESIGN. LINKAGE ATTACHMENTS HAVE DUAL ROTATING SURFACES. MAXIMUM UNLATCHING FORCE IS 20 LB AT THE HANDLE. ACTUATOR AND LINKAGE DESIGNED FOR 150 LB LIMIT LOAD AT THE HANDLE. POSITIVE MARGINS ON ALL COMPONENTS. SEAL COMPRESSIVE FORCE ASSISTS UNLATCHING. LATCH AND LINKAGE MATERIALS (INCONEL, A286 CRES AND BERYLLIUM COPPER) CHOSEN FOR HIGH STRENGTH AND LOW WEAR. DRY FILM LUBE ON BEARING SURFACES. HATCH WITHSTANDS DIFFERENTIAL PRESSURE IN BOTH DIRECTIONS. DESIGN STRESS ANALYSIS REPORT SD77-SH-0178, VOL. 8.

**(B) TEST:**

QUALIFICATION TESTS: LATCHES AND ACTUATOR SYSTEM QUALIFIED BY SIMILARITY (PER CR-28-593201-001C) TO THE MECHANISMS ON THE INGRESS/EGRESS HATCH. REFERENCE FMEA/CIL 02-4A-593201-01. ACTUATOR ALSO COMPONENT QUALIFIED BY SIMILARITY TO ACTUATOR ON INGRESS/EGRESS HATCH (PER CR-28-287-0036-0006C); REFERENCE FMEA/CIL 02-4A-593202-01. CERTIFICATION BY SIMILARITY/ANALYSIS (PER MF004-014) INCLUDED: FUNGUS, SALT/FOG, OZONE, SAND/DUST, TEMPERATURE CYCLE, CRASH/SHOCK, ACCELERATION, CABIN ATMOSPHERE, LIFE CYCLE (2,000 CYCLES), VIBRATION AND STRUCTURAL LOAD REQUIREMENTS.

CERTIFICATION TESTS INCLUDED: ZERO-"G" AND ONE-"G" OPERATION (USING APPROPRIATE GSE EQUIPMENT) AND HATCH SEALING/LEAK TEST (WITH 15.0 PSID ACROSS HIGH-PRESSURE SIDE OF HATCH, WITH MAXIMUM ALLOWABLE LEAK RATE OF 1.03 SCIM), PROOF PRESSURE 17.7 PSID FOR 2.0 +/- 1.0 MINUTE (PER MLD206-0089). LATCH MECHANISM INSTALLED AND RIGGED PER TECH ORDER INSTALLATION M072-593301.

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

**(C) INSPECTION:****RECEIVING INSPECTION**

MATERIAL AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION.

**CONTAMINATION CONTROL**

ASSEMBLY IS PERFORMED IN CLEAN ENVIRONMENT WHICH IS MONITORED BY INSPECTION.

**ASSEMBLY/INSTALLATION**

ASSEMBLY, ADJUSTMENT, TORQUING AND RIGGING ARE VERIFIED BY INSPECTION (M072-593301).

**NONDESTRUCTIVE EVALUATION**

PENETRANT INSPECTION OF DETAIL HARDWARE IS VERIFIED BY INSPECTION.

**CRITICAL PROCESSES**

DRY FILM LUBRICATION IS VERIFIED BY INSPECTION.

**TESTING**

TESTING IS VERIFIED BY INSPECTION.

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FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE

NUMBER: M8-1MR-M002-02

(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:

MIR 1 - IF EXTERNAL AIRLOCK AFT HATCH CANNOT BE OPENED, NO OPERATIONAL WORKAROUND IS POSSIBLE BECAUSE LATCH MECHANISM IS ON SPACELAB SIDE OF HATCH AND IS INACCESSIBLE TO CREW MEMBERS IN EXTERNAL AIRLOCK.

MULTI-MIR - NO OPERATIONAL WORKAROUND AT THE HATCH LEVEL IS FEASIBLE BECAUSE EXTERNAL AIRLOCK AFT HATCH LATCH MECHANISM IS ON THE PAYLOAD BAY SIDE OF THE HATCH AND IS INACCESSIBLE TO CREWMEMBERS INSIDE THE EXTERNAL AIRLOCK.

- APPROVALS -

PRODUCT ASSURANCE ENGR : M. W. GUENTHER  
 PAE MANAGER : W. R. MARLOWE  
 DESIGN ENGINEER : T. S. COOK  
 CHIEF ENGINEER : B. J. BRANT  
 NASA SSMA :  
 NASA SUBSYSTEM MANAGER :  
 JSC MOO :

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