

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE

NUMBER: M8-1SS-BM033-X
(APPLIES ONLY TO THE PMA 2/3)

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 0 DEC, 1996

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: HATCH ASSEMBLY RSC-ENERGIA	33U.4371.016-02 33U.4371.016-02
SRU	: HINGE MECHANISM, ASSEMBLY RSC-ENERGIA	33U.8364.081 ARM RIGHT, 33U.8251.311 BRACKET; 33U.8364.082 ARM LEFT, 33U.8251.310 BRACKET;

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
ASSEMBLY, LEFT/RIGHT HINGE MECHANISM

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 2
TWO

FUNCTION:
 PROVIDES HATCH OPENING/CLOSING. CONSISTS OF ARMS AND BRACKETS BETWEEN WHICH AN AXIS WITH SPHERICAL BEARINGS IS INSTALLED. SPHERICAL BEARINGS HAVE THREE ROTATING SURFACES.

MAINTAINABILITY
REPAIR METHOD - REPLACEMENT (WITH THE AVAILABILITY OF SPARE SET AND WHEN THE OCCASION REQUIRES).

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

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE

NUMBER: M8-1SS-BM033- 01
 (APPLIES ONLY TO THE PMA 2/3)

REVISION# 1 JAN, 1997

SUBSYSTEM NAME: MECHANICAL - EDS
 LRU: HATCH ASSEMBLY
 ITEM NAME: HINGE ASSEMBLY

CRITICALITY OF THIS
 FAILURE MODE: 2R3

FAILURE MODE:
 FAILS TO ROTATE (OPEN OR CLOSED)

MISSION PHASE:
 OO ON-ORBIT

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

CAUSE:
 ROLLER BEARING FAILURE DUE TO: CONTAMINATION/FOREIGN OBJECT/DEBRIS,
 FAILURE/DEFLECTION OF INTERNAL PART, DEFECTIVE PART/MATERIAL, PHYSICAL
 BINDING/JAMMING

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

REDUNDANCY SCREEN A) PASS
 B) FAIL
 C) PASS

PASS/FAIL RATIONALE:

A)

B)

FAILS SCREEN "B" SINCE LOSS OF A SINGLE ROTATING SURFACE IS NOT DETECTABLE IN FLIGHT.

C)

METHOD OF FAULT DETECTION:

NONE FOR FIRST FAILURE. SECOND ROTATING SURFACE CAN BE DETECTED THROUGH VISUAL OBSERVATION - ELEVATED FORCE DURING OPERATION.

REMARKS/RECOMMENDATIONS:

THE HATCH ASSEMBLY CONTAINING THE HINGE IS CLOSED AND SEALED ON THE GROUND. 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. HINGE CONTAINS TRIPLE ROTATING SURFACES.

- FAILURE EFFECTS -

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE
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(A) SUBSYSTEM:

NO EFFECT FIRST FAILURE. HATCH CANNOT BE PLACED IN ITS OPEN/STOWED POSITION AND/OR ITS CLOSED/ LATCHED POSITION IF ITS HINGE ASSEMBLY FAILS TO ROTATE FOLLOWING THIRD ROTATING SURFACE FAILURE. 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 FOLLOWING THIRD ROTATING SURFACE FAILURE 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:

NO EFFECT FIRST AND SECOND FAILURE. THIRD ROTATING SURFACE FAILURE WILL PRECLUDE HATCH OPENING RESULTING IN LOSS OF PRIMARY MISSION OBJECTIVES- LOSS OF CREW ACCESS TO 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:

FIRST ROTATING SURFACE FAILURE - NO EFFECT

SECOND ROTATING SURFACE FAILURE - NO EFFECT, LOSS OF REDUNDANCY ONLY.

THIRD ROTATING SURFACE FAILURE - LOSS OF CAPABILITY TO OPEN OR CLOSE THE HATCH.

IF THIRD FAILURE OCCURS DURING HATCH CLOSING - NO INITIAL EFFECT SINCE HATCH IS NOT COMPLETELY CLOSED FOLLOWING FIRST MISSION. HOWEVER, SUBSEQUENT DOCKINGS MAY BE IMPACTED DUE TO A MISALIGNED TARGET.

IF THIRD FAILURE OCCURS DURING HATCH OPENING - INABILITY OF ORBITER CREW TO ACCESS SPACE STATION OR SPACE STATION CREW TO ACCESS ORBITER (MANNED SPACE STATION) THROUGH AFFECTED PMA RESULTING IN LOSS OF PRIMARY MISSION OBJECTIVES. - CRITICALITY 2R3

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

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

WORST CASE, THERE IS NO WORKAROUND TO CIRCUMVENT A HINGE ASSEMBLY FAILURE THAT PREVENTS OPENING OR CLOSING OF THE HATCH.

- TIME FRAME -

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:

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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**

-DISPOSITION RATIONALE-

(A) DESIGN:

LOW PROBABILITY OF HINGE FAILURE. CONSISTS OF ARMS AND BRACKETS BETWEEN WHICH AN AXIS WITH SPHERICAL BEARINGS IS INSTALLED. HINGE BEARINGS HAVE TRIPLE ROTATING SURFACES. HIGH MECHANICAL ADVANTAGE OF HATCH OPENING FORCE ABOUT HINGE LINE WILL UNJAM HINGE.

(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

ALL 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, AND CHEMICAL PLATING VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

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

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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 HINGE ASSEMBLIES ARE LOCATED 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 ONE OR BOTH HINGES BY REMOVING THEIR FOUR 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. FROLOV
NASA SSMA :
NASA SUBSYSTEM MANAGER :
JSC MOD :

[Handwritten signatures and initials over horizontal lines]