

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE

NUMBER: M8-1SS-BM006-X
 (DOESNT APPLY TO PMA2/3
 PASSIVE MECHANISM)

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 1 DEC, 1996

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: GUIDE RING ASSEMBLY RSC-ENERGIA	33U.6271.011-09(SOFT) 33U.6271.011-05 (PMA1)
SRU	: ASSEMBLY, CAPTURE LATCH RSC-ENERGIA	33U.6322.025 33U.6322.025

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
 CAPTURE LATCH ASSEMBLY

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 3
 THREE (ONE PER GUIDE PEDAL)

FUNCTION:

THREE ACTIVE (CAPTURE) LATCHES, ONE ON EACH GUIDE PEDAL OF THE ORBITER DOCKING RING. PROVIDES POSITIVE CAPTURE TO THREE PASSIVE (BODY MOUNTED) LATCHES LOCATED ON THE ISS DOCKING MECHANISM. CAPTURE LATCH ROLLER MECHANISMS MOVE ASIDE DURING CLOSING CONTACT WITH THEIR OPPOSING BODY MOUNTED LATCHES AND ARE SPRING DRIVEN TO LOCK AFTER PASSING THE THREE PASSIVE BODY LATCHES (LUGS). TWO ROLLER MECHANISMS LOCATED ON EACH CAPTURE LATCH ASSEMBLY PROVIDE A REDUNDANT MEANS OF CAPTURE.

UPON RECEIPT OF A "CLOSE CAPTURE LATCH" COMMAND, POWER IS APPLIED THROUGH REDUNDANT "LATCH MOTOR OPEN" SENSOR CONTACT SETS TO A SINGLE ACTUATOR MOTOR TO EXTEND BOTH ROLLERS OF ONE CAPTURE LATCH ASSEMBLY. A "LATCH INDICATION CLOSED" SENSOR ON EACH ACTUATOR SENSES THE CLOSED POSITION OF THE LATCH AND SENDS REDUNDANT SIGNALS TO THE DOCKING CONTROL PANEL VIA THE DSCU TO ILLUMINATE THE "LATCHES CLOSED" LIGHT WHEN ALL THREE CAPTURE LATCHES ARE CLOSED.

UPON RECEIPT OF AN "OPEN CAPTURE LATCH" COMMAND (FOLLOWING COMPLETION OF THE DOCKING PROCESS), POWER IS APPLIED THROUGH REDUNDANT "LATCH MOTOR CLOSED" SENSOR CONTACT SETS TO A SINGLE ACTUATOR MOTOR TO RETRACT BOTH ROLLERS OF THE CAPTURE LATCH ASSEMBLY FOR UNDOCKING OF THE ISS AND ORBITER (NOMINAL UNDOCKING IS NOT PLANNED TO PMA1 MECHANISM). A "LATCH INDICATION OPEN" SENSOR LOCATED ON EACH CAPTURE LATCH ACTUATOR SENSES THE OPEN POSITION OF THE LATCH AND SENDS REDUNDANT SIGNALS TO THE DSCU TO ILLUMINATE THE "LATCHES OPEN" INDICATOR LIGHT ON THE DOCKING

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CONTROL PANEL AND COMMAND RING TO RETRACT WHEN THE SENSOR ON ALL THREE CAPTURE LATCH ACTUATORS IS CLOSED.

THE THIRD CONTACT SET OF EACH "LATCH INDICATION OPEN" AND "LATCH INDICATION CLOSED" SENSOR IS UTILIZED FOR GROUND MONITORING OF CAPTURE LATCH POSITION. CAPTURE LATCH "INITIAL POSITION" IS ALSO DOWNLINKED FOR GROUND MONITORING.

IN THE EVENT A CAPTURE LATCH FAILS TO OPEN, THE MANUAL LATCH/UNBLOCKING DEVICE CONTAINED BEHIND THE CAPTURE LATCH ASSEMBLY WILL PROVIDE MANUAL RELEASE OF THE LATCH. A BUTTON ON EACH SIDE OF THE DEVICE, WHEN DEPRESSED SIMULTANEOUSLY, WILL RELEASE LATCH CONTROL BY THE LATCH ACTUATOR, THUS ALLOWING BOTH CAPTURE LATCH ROLLERS TO RETRACT TO THEIR OPEN POSITION.

**SERVICE IN BETWEEN FLIGHT AND MAINTENANCE CONTROL:
VISUAL INSPECTION, SERVICEABILITY CONTROL, DOCKING WITH CALIBRATING DOCKING MECHANISM.**

MAINTAINABILITY

REPAIR METHOD - REPLACEMENT.

**REFERENCE DOCUMENTS: 33U.6322.025
33U.6271.011-09 ("SOFT")
33U.6271.011-05 (PMA1)**

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE

**NUMBER: M8-1SS-BMOD6- 06
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**SUBSYSTEM NAME: MECHANICAL - EDS
LRU: GUIDE RING ASSEMBLY
ITEM NAME: ASSEMBLY, CAPTURE LATCH**

**CRITICALITY OF THIS
FAILURE MODE: 2R3**

FAILURE MODE:

ONE CAPTURE LATCH INDICATION "CLOSED" SENSOR CONTACT SET FAILS OPEN

MISSION PHASE:

OO ON-ORBIT

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

CAUSE:

**CONTAMINATION, STRUCTURAL FAILURE DUE TO MECHANICAL/THERMAL SHOCK OR
MANUFACTURE/MATERIAL DEFECT**

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? NO

**REDUNDANCY SCREEN A) PASS
B) PASS
C) FAIL**

PASS/FAIL RATIONALE:

A)

B)

C)

**FAILS REDUNDANCY SCREEN "C" SINCE AN OPEN/LOOSE CONNECTOR CAN RESULT IN
LOSS OF ALL INDICATION SIGNALS.**

METHOD OF FAULT DETECTION:

**VISUAL OBSERVATION - LOSS OF "LATCHES CLOSED" INDICATION WHEN REQUIRED. IF
FAILURE OF SENSOR DOES NOT AFFECT THIRD CONTACT SET GROUND PERSONNEL
CAN DETERMINE "CLOSED" POSITION OF CAPTURE LATCHES THROUGH TELEMETRY
DATA.**

MASTER MEAS. LIST NUMBERS: V53X0754E

REMARKS/RECOMMENDATIONS:

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SENSOR CONTAINS THREE CONTACT SETS TWO OF WHICH WOULD HAVE TO FAIL TO LOSE THE "LATCHES CLOSED" INDICATION ON THE DOCKING CONTROL PANEL. THE THIRD CONTACT SET PROVIDES FOR TELEMETRY DATA.

- FAILURE EFFECTS -

(A) SUBSYSTEM:

FIRST CONTACT SET FAILS OPEN - LOSS OF "LATCHES CLOSED" SIGNAL TO DSCU FROM A SINGLE CONTACT SET. SECOND CONTACT SET FAILS OPEN - LOSS OF ASSOCIATED "LATCHES CLOSED" INDICATION ON THE DOCKING CONTROL PANEL. THIRD CONTACT SET FAILS OPEN - LOSS OF BOTH IN-FLIGHT AND GROUND MONITORING OF CAPTURE LATCH CLOSED POSITION.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT ON INTERFACING SUBSYSTEMS.

(C) MISSION:

NO EFFECT UNTIL ALL CAPTURE LATCH INDICATIONS ARE LOST, AT WHICH TIME CREW DECISION TO ABORT DOCKING WOULD RESULT IN LOSS OF MISSION OBJECTIVES.

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

NO EFFECT ON CREW AND VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

FIRST CONTACT SET FAILURE - NO EFFECT.

SECOND CONTACT SET FAILURE - LOSS OF "LATCHES CLOSED" INDICATION ON THE DOCKING CONTROL PANEL.

THIRD CONTACT SET FAILURE - LOSS OF IN-FLIGHT AND GROUND CAPABILITY TO DETERMINE ALL CAPTURE LATCHES CLOSED POSITION.

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

(F) RATIONALE FOR CRITICALITY CATEGORY DOWNGRADE:

FOURTH FAILURE (LOSS OF WORKAROUND - CAPTURE LATCH DRIVE INDICATION) - IF FOURTH FAILURE OCCURS PRIOR TO DOCKING THE CREW WOULD NOT BE 100% CERTAIN THAT THE CAPTURE LATCHES ARE IN THEIR CLOSED POSITIONS. WORST CASE, CREW ACTION TO ABORT DOCKING WOULD RESULT IN LOSS OF MISSION OBJECTIVES.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: HOURS TO DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS TO MINUTES

TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: SECONDS

IS TIME REQUIRED TO IMPLEMENT CORRECTIVE ACTION LESS THAN TIME TO EFFECT?

YES

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:

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CREW HAS AMPLE TIME TO EVALUATE TELEMETRY DATA TO DETERMINE CAPTURE LATCH POSITION BEFORE A DECISION IS MADE TO ABORT THE DOCKING.

HAZARDS REPORT NUMBER(S): NONE

HAZARD(S) DESCRIPTION:
 N/A

-DISPOSITION RATIONALE-

(A) DESIGN:

SENSOR CONTAINS THREE CONTACT SETS TWO OF WHICH WOULD HAVE TO FAIL TO LOSE THE "LATCHES CLOSED" INDICATION ON THE DOCKING CONTROL PANEL. THE THIRD CONTACT SET PROVIDES FOR TELEMETRY DATA. CAPTURE LATCH ASSEMBLY IS COMPLETELY ENCASED TO PREVENT INTRODUCING CONTAMINATION THAT COULD CAUSE A FAILED OPEN CONDITION ON ALL THREE CONTACT SETS.

(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. ELECTRICAL CIRCUIT VERIFICATION TEST
2. INSULATION ELECTRICAL RESISTANCE TEST
3. CAPTURE LATCH FUNCTIONAL PERFORMANCE TEST
4. AXIAL STIFFNESS IN INITIAL POSITION LOAD TEST
5. CAPTURE LATCH LATCH FORCE LOAD TEST
6. VIBRATION TEST
7. THERMAL VACUUM TEST

DOCKING MECHANISM QUALIFICATION TESTS:

1. ELECTRICAL CIRCUIT VERIFICATION TEST
2. INSULATION ELECTRICAL RESISTANCE TEST
3. TRANSPORTABILITY STRENGTH TEST
4. VIBRATION TEST
5. SHOCK-BASIC DESIGN TEST
6. THERMAL VACUUM TEST
7. SIX-DEGREE-OF-FREEDOM TEST
8. SERVICE LIFE TEST
9. EXTEND/RETRACT MECHANISM LIMIT LOAD TEST
10. EXTEND/RETRACT MECHANISM ULTIMATE LOAD TEST
11. CAPTURE AND BODY LATCH ULTIMATE LOAD TEST
12. DISASSEMBLY INSPECTION

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

(C) INSPECTION:
 RECEIVING INSPECTION

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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, SOLDERING, CHEMICAL PLATING, AND CURING VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

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

TESTING

ATP/QTP/OMRSD 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:

CREW CAN EVALUATE TELEMETRY DATA TO DETERMINE CAPTURE LATCH POSITION.

- APPROVALS -

PRODUCT ASSURANCE ENGR. :
DESIGN ENGINEER :
NASA SS/MA :
NASA SUBSYSTEM MANAGER :
JSC MOD :

M. NIKOLAYEVA
E. BOBROV

[Handwritten signatures and initials over approval lines]