

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-BM008- 10
(DOESN'T APPLY TO PMA2/3
PASSIVE MECHANISM)

REVISION# 1 DEC, 1996

SUBSYSTEM NAME: MECHANICAL - EDS
LRU: GUIDE RING ASSEMBLY
ITEM NAME: ASSEMBLY, CAPTURE LATCH

CRITICALITY OF THIS
FAILURE MODE: 2R3

FAILURE MODE:
ONE CAPTURE LATCH MOTOR "OPEN" 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) FAIL
 C) FAIL

PASS/FAIL RATIONALE:
A)

B)
FAILS REDUNDANCY SCREEN "B" SINCE A FAILS OPEN CONDITION ON A SINGLE
CONTACT SET IS NOT DETECTABLE IN FLIGHT.

C)
FAILS REDUNDANCY SCREEN "C" SINCE NON-CONDUCTIVE CONTAMINATION CAN
RESULT IN A FAILS OPEN CONDITION ON ALL CONTACT SETS.

METHOD OF FAULT DETECTION:
NO EFFECT FIRST CONTACT SET FAILURE. SECOND CONTACT SET FAILURE WOULD BE
DETECTED THROUGH VISUAL OBSERVATION - LOSS OF "LATCHES CLOSED" INDICATION
WHEN REQUIRED. IF FAILURE OF SWITCH DOESN'T AFFECT THIRD CONTACT SET
GROUND PERSONNEL CAN DETERMINE "CLOSED" POSITION OF CAPTURE LATCHES
THROUGH TELEMETRY DATA.

REMARKS/RECOMMENDATIONS:

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REDUNDANT CONTACT SETS PROVIDE POWER TO A SINGLE ACTUATOR MOTOR TO CLOSE ONE CAPTURE LATCH ASSEMBLY. ONLY ONE CONTACT SET IS REQUIRED TO ENABLE POWER TO THE MOTOR. CAPTURE LATCHES ARE CLOSED DURING GROUND OPERATIONS PRIOR TO FLIGHT AND REMAIN CLOSED THROUGHOUT THE DOCKING RING CAPTURE PROCESS.

- FAILURE EFFECTS -

(A) SUBSYSTEM:

FIRST CONTACT SET FAILURE - NO EFFECT. SECOND CONTACT SET FAILURE - "CLOSE LATCH" POWER TO AFFECTED CAPTURE LATCH ACTUATOR MOTOR IS INTERRUPTED. ABILITY TO POWER AFFECT CAPTURE LATCH CLOSED IS LOST. NO EFFECT ON INITIAL DOCKING SINCE CAPTURE LATCHES ARE IN THEIR CLOSED POSITION PRIOR TO FIRST CAPTURE. HOWEVER, SUBSEQUENT DOCKINGS WOULD BE LOST SINCE ONLY TWO OF THREE CAPTURES WOULD BE CLOSED.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT ON INTERFACING SUBSYSTEMS.

(C) MISSION:

NO EFFECT ON CURRENT DOCKING. A FAILURE TO CLOSE A CAPTURE LATCH WOULD AFFECT THE CAPABILITY TO PERFORM SUBSEQUENT DOCKINGS.

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

NO EFFECT ON CREW AND VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

INITIAL DOCKING - NO EFFECT SINCE CAPTURE LATCHES ARE IN THEIR CLOSED POSITION PRIOR TO CAPTURE. CRITICALITY 3/3 CONDITION.
SUBSEQUENT DOCKINGS - A FAILED OPEN CONDITION ON BOTH CONTACT SETS ON ONE CAPTURE LATCH MOTOR "OPEN" SENSOR WOULD PREVENT CLOSING OF AFFECTED CAPTURE LATCH. WITH ONLY TWO CAPTURE LATCHES CLOSED SECOND CAPTURE MAY BE POSSIBLE BUT MATING OF BOTH DOCKING MECHANISMS FOR STRUCTURAL LATCHING WOULD BE LOST, SINCE RING WOULD NOT BE ALIGNED. CRITICALITY 2R3 CONDITION.

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

(F) RATIONALE FOR CRITICALITY CATEGORY DOWNGRADE:

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

- 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: N/A

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

N/A

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**RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:
THERE IS NO CORRECTIVE ACTION TO THIS FAILURE OTHER THAN TO ABORT A SECOND
DOCKING ATTEMPT.**

HAZARDS REPORT NUMBER(S): NONE

**HAZARD(S) DESCRIPTION:
N/A**

-DISPOSITION RATIONALE-

(A) DESIGN:

REDUNDANT CONTACT SETS PROVIDE POWER TO A SINGLE ACTUATOR MOTOR TO CLOSE ONE CAPTURE LATCH ASSEMBLY. ONLY ONE CONTACT SET IS REQUIRED TO ENABLE POWER TO THE MOTOR. CAPTURE LATCHES ARE CLOSED DURING GROUND OPERATIONS PRIOR TO FLIGHT AND REMAIN CLOSED THROUGHOUT THE DOCKING RING CAPTURE PROCESS. CAPTURE LATCH ASSEMBLY IS COMPLETELY ENCASED TO PREVENT INTRODUCING CONTAMINATION THAT COULD CAUSE A FAILED OPEN CONDITION ON ALL 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.

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(C) INSPECTION:

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, 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:

NONE. CAPTURE LATCHES ARE NORMALLY CLOSED PRIOR TO CAPTURE.

- APPROVALS -

PRODUCT ASSURANCE ENGR.	:	M. NIKOLAYEVA	:
DESIGN ENGINEER	:	E. BOBROV	:
NASA SS/MA	:		:
NASA SUBSYSTEM MANAGER	:		:
JSC MOD	:		:

Handwritten signatures and initials are present over the approval lines, including what appears to be 'M. Nikolayeva', 'E. Bobrov', and other names.