

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

CRITICALITY OF THIS
FAILURE MODE: 2/2

FAILURE MODE:
INADVERTENTLY OPENS (BOTH ROLLERS)

MISSION PHASE:
OO ON-ORBIT

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

CAUSE:
MANUAL LATCH/UNBLOCKING DEVICE INADVERTENTLY RELEASES - COMPLETE SPRING
FAILURE DUE TO MECHANICAL/THERMAL SHOCK OR MANUFACTURE/MATERIAL DEFECT
ACCOMPANIED WITH VIBRATION

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 - CREW COULD VISUALLY OBSERVE ONE OR MORE OPEN
CAPTURE LATCHES DURING CAPTURE, ATTENUATION, AND RING RETRACTION. AN
OPEN MANUAL LATCH/UNBLOCKING DEVICE HANDLE CAN BE VISUALLY DETECTED
DURING IVA. INSTRUMENTATION - FAILURE WOULD BE DETECTABLE BY EVALUATION OF
TELEMETRY DATA. A SWITCH LOCATED UNDER THE MANUAL LATCH/UNBLOCKING
DEVICE LEVER SENSES THE POSITION OF THIS LEVER AND DOWNLINKS POSITION DATA
TO GROUND PERSONNEL.

REMARKS/RECOMMENDATIONS:

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INADVERTENT OPENING OF A CAPTURE LATCH WOULD MOST LIKELY OCCUR AS THE RESULT OF AN ELECTRICAL FAILURE AND NOT A MECHANICAL ONE.

- FAILURE EFFECTS -

(A) SUBSYSTEM:

AFFECTED CAPTURE LATCH ASSEMBLY WILL NOT BE IN ITS CLOSED POSITION. LOSS OF CAPABILITY TO LATCH AFFECTED CAPTURE LATCH ASSEMBLY ON ORBITER/PMA1 DOCKING MECHANISM TO OPPOSING BODY MOUNTED LATCH ON ISS DOCKING MECHANISM. ALTHOUGH IT MAY BE POSSIBLE TO CAPTURE AND RETRACT THE DOCKING RING WITH ONLY TWO CLOSED CAPTURE LATCHES, MATING OF THE TWO DOCKING MECHANISMS FOR CLOSING STRUCTURAL HOOKS WOULD BE IMPAIRED. IF TWO CAPTURE LATCHES INADVERTENTLY OPEN DURING RING ATTENUATION, FOLLOWING CAPTURE, UNCONTROLLED CLOSING PARAMETERS COULD OCCUR.

(B) INTERFACING SUBSYSTEM(S):

POTENTIAL DAMAGE TO ORBITER/PMA1 STRUCTURE IF ORBITER (PMA1)/ISS COLLIDE DUE TO FAILURE OF TWO CAPTURE LATCHES DURING RING ATTENUATION.

(C) MISSION:

WORST CASE, LOSS OF DOCKING CAPABILITIES RESULTING IN LOSS MISSION OBJECTIVES FOLLOWING AN INADVERTENT OPENING OF A SINGLE CAPTURE LATCH.

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

NO EFFECT FIRST FAILURE. POTENTIAL FOR COLLISION BETWEEN BOTH VEHICLES IF SECOND CAPTURE LATCH INADVERTENTLY OPENS DURING ATTENUATION.

(E) FUNCTIONAL CRITICALITY EFFECTS:

FIRST CAPTURE LATCH FAILURE - WORST CASE, IF FAILURE OCCURS PRIOR TO CAPTURE OR DURING RING RETRACTION, DOCKING WOULD BE IMPAIRED RESULTING IN LOSS OF MISSION OBJECTIVES. - CRITICALITY 2/2 CONDITION.
 SECOND CAPTURE LATCH FAILURE - WORST CASE, IF FAILURE OCCURS DURING RING ATTENUATION, A POTENTIAL COLLISION BETWEEN ORBITER/PMA1 AND ISS EXISTS.

DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 1R2

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

THIRD FAILURE - INABILITY TO FIRE RCS (APPLIES ONLY TO THE ORBITER). CREW IS UNABLE TO STOP A POTENTIAL COLLISION BETWEEN ORBITER AND ISS. WORST CASE, DAMAGE RESULTING FROM COLLISION COULD RESULT IN LOSS OF CREW AND VEHICLE. - CRITICALITY 1R3. THERE ARE NO WORKAROUNDS TO AN INADVERTENT OPENING OF A SINGLE CAPTURE LATCH PRIOR TO CAPTURE OR DURING RING RETRACTION. AS SUCH, THE CRITICALITY OF THIS FAILURE MODE IS ASSIGNED A 2/2 BASED ON THE INABILITY TO PERFORM DOCKING.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: MINUTES

TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS

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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:
THERE IS NO WORKAROUND IF FIRST FAILURE OCCURS PRIOR TO CAPTURE. HOWEVER
IF SECOND FAILURE OCCURS DURING RING ATTENUATION, CREW HAS AMPLE TIME TO
OPEN CAPTURE LATCHES AND FIRE RCS JETS (APPLIES ONLY TO THE ORBITER) TO
AVOID A POTENTIAL COLLISION BETWEEN ORBITER AND ISSA.

HAZARDS REPORT NUMBER(S): ORB! 402B

HAZARD(S) DESCRIPTION:
UNCONTROLLED/INADVERTENT COLLISION BETWEEN ORBITER AND ISSA.

•DISPOSITION RATIONALE•

(A) DESIGN:

AN INADVERTENT RELEASE OF THE MANUAL LATCH/UNBLOCKING DEVICE IS
CONSIDERED VERY REMOTE. THE DESIGN ALLOWS VERY LITTLE CLEARANCE BETWEEN
THE SPRING HOUSING AND THE SPRING ITSELF AND AS SUCH, THE SPRING IS NOT FREE
TO MOVE Laterally IN THE EVENT OF FRACTURES. IN ADDITION, IF A COMPLETE
SPRING FAILURE, RESULTING IN LOSS OF TENSION, OCCURS THE OUTER BUTTONS
LOCATED AT OPPOSITE SIDES OF THE HANDLE WILL REMAIN INTACT. ADDITIONAL
VIBRATION WOULD BE REQUIRED FOR THESE BUTTONS TO RETRACT THUS ALLOWING
THE HANDLE TO POP OUT. POSITION OF MANUAL LATCH/ UNBLOCKING DEVICE HANDLE
IS SENSED AND DOWNLINKED FOR GROUND MONITORING. INADVERTENT OPENING OF
A CAPTURE LATCH WOULD MOST LIKELY OCCUR AS THE RESULT OF AN ELECTRICAL
FAILURE AND NOT A MECHANICAL ONE.

(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. CAPTURE LATCH FUNCTIONAL PERFORMANCE TEST
2. AXIAL STIFFNESS IN INITIAL POSITION LOAD TEST
3. RETRACTION FORCE LOAD TEST
4. RESTRAINING FORCE LOAD TEST
5. VIBRATION TEST
6. THERMAL VACUUM TEST

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DOCKING MECHANISM QUALIFICATION TESTS:

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

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

(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.

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(E) OPERATIONAL USE:

CREW COULD OPEN REMAINING CAPTURE LATCH AND INITIATE UNDOCKING PROCEDURES TO AVOID COLLISION IF BOTH CAPTURE LATCHES INADVERTENTLY OPEN DURING ATTENUATION. THERE IS NO CORRECTIVE ACTION IF A SINGLE CAPTURE LATCH INADVERTENTLY OPENS PRIOR TO CAPTURE OR DURING RING RETRACTION.

- APPROVALS -

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