

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

NUMBER: MB-1MR-BM006-X

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 2 9/1/95

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: GUIDE RING ASSEMBLY NPO-ENERGIA	33U.6271.011-05 33U.6271.011-05
SRU	: ASSEMBLY, CAPTURE LATCH NPO-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 MIR 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 MIR AND ORBITER. 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 CONTROL PANEL AND COMMAND RING TO RETRACT WHEN THE SENSOR ON ALL THREE CAPTURE LATCH ACTUATORS IS CLOSED.

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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.6271.011-05

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

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REVISION# 1 9/1/95

SUBSYSTEM NAME: MECHANICAL - EDS

LRU: GUIDE RING ASSEMBLY

ITEM NAME: ASSEMBLY, CAPTURE LATCH

CRITICALITY OF THIS

FAILURE MODE: 1R3

**FAILURE MODE:**

ONE CAPTURE LATCH MOTOR "CLOSED" SENSOR CONTACT SET FAILS CLOSED OR SHORTS TO GROUND

**MISSION PHASE:**

OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 104 ATLANTIS

**CAUSE:**

CONTAMINATION, PIECE PART STRUCTURAL FAILURE DUE TO MECHANICAL/THERMAL SHOCK, VIBRATION, OR MANUFACTURER/MATERIAL DEFECT

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

**REDUNDANCY SCREEN**      A) PASS  
    B) N/A  
    C) PASS

**PASS/FAIL RATIONALE:**

A)

B)

N/A - AT LEAST TWO REMAINING PATHS ARE DETECTABLE IN FLIGHT.

C)

**METHOD OF FAULT DETECTION:**

NONE INITIALLY. INSTRUMENTATION - ALTERNATING OPEN AND CLOSED CAPTURE LATCH INDICATIONS WHEN POWER IS NORMALLY OR INADVERTENTLY APPLIED TO A CAPTURE LATCH ACTUATOR MOTOR.

**CORRECTING ACTION:** NONE UNTIL FOURTH FAILURE. THEN CREW COULD OPEN REMAINING CAPTURE LATCH AND INITIATE UNDOCKING PROCEDURES TO AVOID COLLISION IF TWO CAPTURE LATCHES INADVERTENTLY OPEN DURING ATTENUATION.

**REMARKS/RECOMMENDATIONS:**

REDUNDANT CONTACT SETS ARE PROVIDED WITHIN THE MOTOR "OPEN" SENSOR. ONLY ONE "FAILED CLOSED" CONTACT SET IS REQUIRED, ALONG WITH AN INADVERTENT APPLICATION OF POWER, TO CAUSE AN INADVERTENT OPENING OF AFFECTED CAPTURE LATCH. IT TAKES TWO ELECTRICAL FAILURES TO INADVERTENTLY APPLY POWER TO ALL THREE CAPTURE LATCH MOTOR "OPEN" SENSORS.

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**- FAILURE EFFECTS -**

**(A) SUBSYSTEM:**

A GROUND IS INADVERTENTLY APPLIED TO THE "OPEN" WINDINGS OF THE AFFECTED CAPTURE LATCH MOTOR. AFFECTED CAPTURE LATCH WILL CYCLE OPEN AND CLOSED WHEN POWER IS NORMALLY OR INADVERTENTLY APPLIED TO CAPTURE LATCH MOTOR. (POWER CAN BE INADVERTENTLY APPLIED TO THE ACTUATOR MOTOR DUE TO AN ADDITIONAL TWO ELECTRICAL FAILURES.)

**(B) INTERFACING SUBSYSTEM(S):**

NO EFFECT UNTIL SIMILAR FAILURE OCCURS ON MOTOR "CLOSED" SENSOR OF SECOND CAPTURE LATCH (SECOND FAILURE) AND POWER IS INADVERTENTLY APPLIED TO CAPTURE LATCHES (THIRD AND FOURTH FAILURES). THEN POTENTIAL DAMAGE TO ORBITER STRUCTURE IF ORBITER/MIR COLLIDE DUE TO TWO CAPTURE LATCHES INADVERTENTLY OPENING DURING RING ATTENUATION.

**(C) MISSION:**

NO EFFECT UNTIL THIRD FAILURE (INADVERTENT POWER TO CAPTURE LATCH ACTUATOR MOTOR). THEN, CONTINUOUS CYCLING OF CAPTURE LATCH OPEN AND CLOSED COULD PREVENT ONE CAPTURE LATCH FROM LATCHING TO ITS OPPOSING MIR BODY MOUNTED LATCH. WITH ONLY TWO CAPTURE LATCHES CLOSED RING RETRACTION IS POSSIBLE BUT MATING OF THE TWO DOCKING MECHANISMS FOR STRUCTURALLY LATCHING OF THE INTERFACE IS QUESTIONABLE. WORST CASE, LOSS OF STRUCTURAL LATCHING CAPABILITIES AND SUBSEQUENT LOSS OF MISSION OBJECTIVES.

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

POTENTIAL LOSS OF CREW OR VEHICLE DUE TO UNCONTROLLED CLOSING PARAMETERS FOLLOWING FIFTH FAILURE.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

FIRST FAILURE (ONE CONTACT SET FAILS CLOSED OR SHORTS TO GROUND ON MOTOR "CLOSED" SENSOR OF FIRST CAPTURE LATCH) - NO EFFECT.  
SECOND AND THIRD FAILURES (TWO ELECTRICAL FAILURES RESULTING IN POWER TO THE AFFECTED CAPTURE LATCH ACTUATOR MOTOR) - AFFECTED CAPTURE LATCH WILL CYCLE OPEN AND CLOSED WHEN NOT REQUIRED. CONTINUOUS CYCLING OF CAPTURE LATCH OPEN AND CLOSED COULD PREVENT ONE CAPTURE LATCH FROM LATCHING TO ITS OPPOSING MIR BODY MOUNTED LATCH. WITH ONLY TWO CAPTURE LATCHES CLOSED RING RETRACTION IS POSSIBLE BUT MATING OF THE TWO DOCKING MECHANISMS FOR STRUCTURALLY LATCHING OF THE INTERFACE IS QUESTIONABLE. WORST CASE, LOSS OF STRUCTURAL LATCHING CAPABILITIES AND SUBSEQUENT LOSS OF MISSION OBJECTIVES. - CRITICALITY 2R3 CONDITION  
FOURTH FAILURE (ONE CONTACT SET FAILS CLOSED OR SHORTS TO GROUND ON MOTOR "CLOSED" SENSOR OF SECOND CAPTURE LATCH - TWO CAPTURE LATCHES CONTINUOUSLY CYCLE OPEN AND CLOSED. WORST CASE, IF FAILURE OCCURS DURING RING ATTENUATION, A POTENTIAL COLLISION BETWEEN ORBITER AND MIR EXISTS.

**DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 1R3**

**(F) RATIONALE FOR CRITICALITY DOWNGRADE:**

FIFTH FAILURE (INABILITY TO FIRE RCS) - CREW IS UNABLE TO STOP A POTENTIAL COLLISION BETWEEN ORBITER AND MIR. WORST CASE, DAMAGE RESULTING FROM COLLISION COULD RESULT IN LOSS OF CREW AND VEHICLE.

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**- TIME FRAME -**

**TIME FROM FAILURE TO CRITICAL EFFECT: MINUTES**

**TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS**

**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:  
CREW HAS AMPLE TIME TO FIRE RCS JETS TO AVOID A POTENTIAL COLLISION  
BETWEEN ORBITER AND MIR.**

**HAZARDS REPORT NUMBER(S): ORBI 402A**

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

**- APPROVALS -**

<b>DESIGN ENGINEER</b>	:	<b>M. NIKOLAYEVA</b>	:	
<b>DESIGN MANAGER</b>	:	<b>A. SOUBCHEV</b>	:	