

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

NUMBER: M8-1MR-BM001-X

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 1 9/1/95

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: STRUCTURAL LATCH MECHANISM NPO-ENERGIA	33U.6365.010-05 33U.6365.010-05
SRU	: ASSY, STRUCTURAL HOOK (SLAVE) NPO-ENERGIA	33U.6366.007-05 33U.6366.007-05
SRU	: ASSY, STRUCTURAL HOOK (SLAVE) NPO-ENERGIA	33U.6366.008-05 33U.6366.008-05
SRU	: ASSY, STRUCTURAL HOOK (DRIVE) NPO-ENERGIA	33U.6366.009-05 33U.6366.009-05
SRU	: ASSY, STRUCTURAL HOOK (DRIVE) NPO-ENERGIA	33U.6366.010-05 33U.6366.010-05

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
STRUCTURAL HOOK ASSEMBLY

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 12
TWELVE

FUNCTION:

PERFORMS OPENING AND CLOSING OF ONE ACTIVE HOOK ON ORBITER DOCKING MECHANISM TO OPPOSITE PASSIVE HOOK ON MIR DOCKING MECHANISM. TWELVE STRUCTURAL HOOK ASSEMBLIES ON ORBITER DOCKING MECHANISM ARE PROVIDED, TWO SETS OF SIX HOOK ASSEMBLIES. EACH SET IS CONTROLLED SIMULTANEOUSLY BY ONE ACTUATOR. EACH ACTUATOR IS MECHANICALLY LINKED TO ONE DRIVE STRUCTURAL HOOK ASSEMBLY. A PULLEY CONTAINED ON THE DRIVE ASSEMBLY IS MECHANICALLY LINKED TO A PULLEY ON EACH OF THE FIVE SLAVE HOOK ASSEMBLIES THROUGH A SINGLE MECHANICAL GABLE. ROTATION OF THE DRIVE HOOK ASSEMBLY PROVIDES SIMULTANEOUS ROTATION OF THE FIVE SLAVE HOOK ASSEMBLIES. THE STRUCTURAL LATCH ACTUATOR CONTAINS A "HOOK CLOSED" SENSOR, A "HOOK OPEN" SENSOR, AND A "HOOK-IN-BETWEEN" SENSOR TO MONITOR POSITION OF ONE SET OF SIX STRUCTURAL HOOKS. EACH IS DESCRIBED BELOW.

"HOOK CLOSED" SENSOR. THE "HOOK CLOSED" SENSOR IS USED TO ILLUMINATE ITS APPROPRIATE "HOOK 1 CLOSED" OR "HOOK 2 CLOSED" INDICATOR ON THE DOCKING CONTROL PANEL. THESE INDICATIONS ARE DOWNLINKED FOR GROUND MONITORING OF EACH SET OF LATCH HOOKS "CLOSED" POSITION. HOOK "CLOSED" SIGNAL IS ALSO UTILIZED BY THE DSCU TO TURN OFF THE STRUCTURAL LATCH ACTUATORS ONCE THE HOOKS HAVE CLOSED.

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"HOOK OPEN" SENSOR. THE "HOOK OPEN" SENSOR IS USED TO ILLUMINATE ITS APPROPRIATE "HOOK 1 OPEN" OR "HOOK 2 OPEN" INDICATOR ON THE DOCKING CONTROL PANEL. THESE INDICATIONS ARE DOWNLINKED FOR GROUND MONITORING OF EACH SET OF LATCH HOOKS "OPEN" POSITION. THESE SIGNALS ARE ALSO USED TO TURN OFF THE STRUCTURAL LATCH ACTUATOR ONCE THE HOOKS HAVE OPENED.

"HOOK-IN-BETWEEN" SENSOR. THE "HOOK IN-BETWEEN" SENSOR IS USED TO SENSE WHEN EACH SET OF SIX LATCH HOOKS ARE IN A POSITION BETWEEN FULLY OPENED AND FULLY CLOSED. WHEN THE SENSOR IS CLOSED REDUNDANT SIGNALS ARE SENT TO THE DSCU TO STOP MOVEMENT OF THE RING AND TO DE-ENERGIZE THE FIXATORS. THE "HOOK-IN-BETWEEN" SIGNAL IS NOT UTILIZED FOR IN-FLIGHT OR GROUND MONITORING PURPOSES.

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

MAINTAINABILITY

REPAIR METHOD - NONE (REPAIRING IN MANUFACTURING CONDITIONS ONLY).

REFERENCE DOCUMENTS: 33U.6121.038-05
33U.6201.008-05
33U.6365.010-05
33U.6366.007-05
33U.6366.008-05
33U.6366.009-05
33U.6366.010-05

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL FAILURE MODE
NUMBER: M8-1MR-BM001-12**

REVISION# 2 9/1/95

**SUBSYSTEM NAME: MECHANICAL - EDS
LRU: STRUCTURAL LATCH MECHANISM
ITEM NAME: ASSEMBLY, STRUCTURAL HOOK**

**CRITICALITY OF THIS
FAILURE MODE: 1R3**

**FAILURE MODE:
FAILURE OF PYRO SUBSYSTEM TO SEPARATE**

**MISSION PHASE:
OO ON-ORBIT**

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 104 ATLANTIS

**CAUSE:
PYRO BOLT FAILS TO FRACTURE DUE TO: INADEQUATE OUTPUT ENERGY OF
EXPLOSIVE MIX; OVER-STRENGTH MATERIAL; DUAL BRIDGEWIRE FAILURE**

**HOOK RE-ENGAGED DUE TO LEAF SPRING ACTUATED LOCK PIN FAILS TO EXTEND AS
THE RESULT OF: EXCESSIVE FRICTION ON LOCK PIN; INSUFFICIENT SPRING FORCE;
EXCESSIVE RELEASE ENERGY; INSUFFICIENT ENERGY ATTENUATION**

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) PASS**

**PASS/FAIL RATIONALE:
A)
N/A - PYROTECHNIC DEVICES ARE NOT CHECKED DURING GROUND OPERATIONS.**

**B)
N/A - PYROTECHNIC DEVICES ARE NOT CHECKED IN-FLIGHT.**

C)

**METHOD OF FAULT DETECTION:
PHYSICAL OBSERVATION - ORBITER/MIR FAILS TO SEPARATE.**

**CORRECTING ACTION: NONE. ORBITER EMERGENCY PYRO SYSTEM NOT UTILIZED
UNTIL LOSS OF NORMAL UNLATCHING CAPABILITIES. IN THE EVENT THE PYRO
SYSTEM FAILS TO RELEASE A CLOSED STRUCTURAL HOOK, CREW COULD PERFORM
CONTINGENCY EVA TO REMOVE THE 96 BOLTS HOLDING THE DOCKING BASE TO THE
EXTERNAL AIRLOCK. THIS WILL ALLOW ORBITER/MIR SEPARATION TO OCCUR.**

**REMARKS/RECOMMENDATIONS:
EMERGENCY PYRO SYSTEM IS NOT UTILIZED UNTIL LOSS OF NORMAL UNLATCHING
CAPABILITIES.**

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- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF CAPABILITY TO RELEASE ACTIVE (OR PASSIVE) HOOK USING ORBITER EMERGENCY PYRO SYSTEM.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT ON INTERFACING ORBITER SUBSYSTEMS.

(C) MISSION:

NO EFFECT ON DOCKED MISSION OBJECTIVES AS THE RESULT OF PYRO SEPARATION FAILURE. PYRO SEPARATION SYSTEM IS ONLY UTILIZED WHEN THERE IS A NEED TO PERFORM EMERGENCY ORBITER/MIR SEPARATION. HOWEVER THIS FAILURE WILL PRECLUDE SUBSEQUENT DOCKINGS.

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

NO EFFECT UNTIL LOSS OF NORMAL UNLATCHING OPERATIONS. THEN FAILURE TO RELEASE ACTIVE (OR PASSIVE) HOOK USING ORBITER EMERGENCY PYRO SYSTEM WILL RESULT IN LOSS OF NOMINAL ORBITER/MIR SEPARATION CAPABILITY.

(E) FUNCTIONAL CRITICALITY EFFECTS:

FIRST FAILURE - LOSS OF NOMINAL UNLATCHING.

SECOND FAILURE - FAILURE WITHIN PYRO SUBSYSTEM (PYRO BOLT FAILS TO FRACTURE OR LEAF SPRING ACTUATED LOCK PIN FAILS TO EXTEND), WHEN REQUIRED, RESULTING IN LOSS OF ORBITER/MIR SEPARATION CAPABILITY. INABILITY TO NOMINALLY SEPARATE ORBITER FROM MIR.

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

THIRD FAILURE (INABILITY TO EVA TO REMOVE 96 BOLTS) - WORST CASE, INABILITY TO SEPARATE ORBITER FROM MIR RESULTING IN LOSS OF CREW/VEHICLE.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: HOURS TO DAYS**TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS****TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: HOURS****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 PERFORM AN EVA TO REMOVE THE 96 BOLTS HOLDING THE DOCKING BASE TO THE EXTERNAL AIRLOCK BEFORE CREW/VEHICLE ARE LOST.

HAZARDS REPORT NUMBER(S): ORB 401A**HAZARD(S) DESCRIPTION:**

INABILITY TO SEPARATE ORBITER AND MIR.

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- APPROVALS -

DESIGN ENGINEER
DESIGN MANAGER

: M. NIKOLAYEVA
: A. SOUBCHEV

: *[Signature]*
: *[Signature]*