

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.

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

NUMBER: M8-1MR-9M001-X

"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 ONE 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: MB-1MR-BM001-03

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:

SINGLE HOOK FAILS TO LATCH

MISSION PHASE:

OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 104 ATLANTIS

CAUSE:

JAMMED LATCH DUE TO CONTAMINATION OR MECHANICAL/THERMAL SHOCK

BROKEN PULLEY-LATCH CONNECTION, BROKEN HOOK, OR SHEARED PYRO BOLT DUE TO MECHANICAL/THERMAL SHOCK, EXCESSIVE VIBRATION, OR MATERIAL DEFECT

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? N/A

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:

NO INDICATION TO FLIGHT CREW GIVEN A SINGLE HOOK FAILS TO LATCH. SECOND HOOK FAILURE CAN BE DETECTED THROUGH INSTRUMENTATION/PHYSICAL OBSERVATION - POSSIBLE LOSS OF PRESSURE IN ODS.

CORRECTING ACTION: IF LEAKAGE OCCURS DURING IVA, CREW COULD CLOSE APPROPRIATE HATCHES TO ISOLATE LEAKAGE. THEN MIR CREW CAN CLOSE 12 ACTIVE HOOKS ON MIR DOCKING MECHANISM TO THE OPPOSING 12 PASSIVE HOOKS ON ORBITER DOCKING MECHANISM TO INSURE STRUCTURAL/SEAL INTEGRITY BETWEEN BOTH VEHICLES.

REMARKS/RECOMMENDATIONS:

DEFLECTION ANALYSIS HAS INDICATED THAT THE ORBITER/MIR DOCKING MECHANISM INTERFACE CAN BE INITIALLY SEALED FOR PRESSURIZATION WITH 10 ADJACENT ORBITER HOOKS CLOSED. HOWEVER, WITH 10 HOOKS CLOSED DYNAMIC MOVEMENT

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL FAILURE MODE
NUMBER: M8-1MR-8M001-03**

BETWEEN THE VEHICLES COULD CREATE A GAP BETWEEN THE DOCKING MECHANISM AND SEAL, RESULTING IN POSSIBLE LEAKAGE.

- FAILURE EFFECTS -

(A) SUBSYSTEM:

INABILITY TO CLOSE ACTIVE HOOK ON ONE STRUCTURAL HOOK ASSEMBLY USING NORMAL LATCHING OPERATIONS.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT FIRST FAILURE. LOSS OF PRESSURE IN ORBITER HABITABLE AREAS FOLLOWING SIMILAR FAILURE OF SECOND HOOK WITH HATCHES OPEN.

(C) MISSION:

NO EFFECT FIRST FAILURE. SECOND HOOK FAILS TO CLOSE - COULD PREVENT VESTIBULE TUNNEL PRESSURIZATION RESULTING IN LOSS OF IVA OPERATIONS.

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

NO EFFECT FIRST FAILURE. POSSIBLE EXTERNAL LEAKAGE OF HABITABLE PRESSURE GIVEN SIMILAR FAILURE OF SECOND HOOK DURING ON-ORBIT OPERATIONS.

(E) FUNCTIONAL CRITICALITY EFFECTS:

FIRST STRUCTURAL HOOK FAILS TO LATCH - NO EFFECT.
SECOND STRUCTURAL HOOK FAILS TO LATCH - INTERFACE CAN BE INITIALLY PRESSURIZED. HOWEVER, DYNAMIC MOVEMENT BETWEEN ORBITER AND MIR COULD BREAK THE SEAL BETWEEN BOTH MECHANISMS RESULTING IN LEAKAGE OF HABITABLE PRESSURE THROUGH THIS INTERFACE. DURING IVA, ORBITER AND MIR CREW SAFETY IS JEOPARDIZED WITH LOSS OF HABITABLE VOLUME.

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

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

THIRD FAILURE (INABILITY TO CLOSE TWELVE MIR HOOKS) - INABILITY TO STOP LEAKAGE AT THE ORBITER/MIR DOCKING MECHANISM INTERFACE.
FOURTH FAILURE (INABILITY TO CLOSE APPROPRIATE HATCH(S)) - LOSS OF CAPABILITY TO ISOLATE LEAK FROM CREW CABIN. POSSIBLE LOSS OF CREW AND VEHICLE DUE TO INCREASED USE OF CONSUMABLES.

- 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: SECONDS TO MINUTES

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

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL FAILURE MODE
NUMBER: M6-1MR-BM001-03**

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:
CREW HAS AMPLE TIME TO UTILIZE MIR'S TWELVE STRUCTURAL HOOKS TO TIGHTEN THE INTERFACE OR CLOSE APPROPRIATE HATCH(S) TO ISOLATE THE LEAK FROM THE CREW CABIN.

HAZARDS REPORT NUMBER(S): ORBI 511

HAZARD(S) DESCRIPTION:
LOSS OF PRESSURE IN HABITABLE VOLUME.

- APPROVALS -

DESIGN ENGINEER
DESIGN MANAGER

: M. NIKOLAYEVA
: A. SOUBCHEV

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