

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE

NUMBER: M8-1SS-BM024-X

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) 33U.6201.008-08 (PMA2/3)
SRU	: SENSOR RSC-ENERGIA	33U.5319.027 33U.5319.027

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

CAPTURE SENSOR

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 3

THREE

FUNCTION:

THREE SENSORS, LOCATED ON THE GUIDE RING ASSEMBLY, ARE USED TO MONITOR THE RING MATCHING OF BOTH THE ORBITER/PMA1 AND ISS (PMA2/FGB) DOCKING RING ASSEMBLIES. EACH SENSOR CONTAINS TWO REDUNDANT SHORT CONTACTS AND TWO REDUNDANT LONG CONTACTS. THE SHORT CONTACTS OF THE THREE SENSORS ARE CONNECTED IN SERIES AND THE LONG CONTACTS OF THE THREE SENSORS ARE CONNECTED IN PARALLEL. TOGETHER THEY SENSE THE MATING OF THE TWO DOCKING RINGS AND SEND A SIGNAL TO THE DSCU TO ACTIVATE THE HIGH ENERGY (AND LOW ENERGY FOR THE "SOFT" MECHANISM) DAMPERS AND TO ILLUMINATE THE "CAPTURE" INDICATOR LIGHT ON THE DOCKING CONTROL PANEL WHEN ALL THREE SENSORS ACTUATE SIMULTANEOUSLY. THE LONG CAPTURE SIGNAL IS DOWNLINKED TO GROUND PERSONNEL. THESE SENSORS SENSE THE SECOND POINT IN THE AUTOMATIC DOCKING SEQUENCE - MATING OF THE TWO DOCKING RINGS. THE SIGNAL FROM THE PMA2/3 PASSIVE MECHANISM CAPTURE SENSORS IS TRANSFERRED TO ISS (FGB) TO TURN OFF DYNAMIC REGIME (DOESN'T APPLY TO THE 2A MISSION).

SERVICE IN BETWEEN FLIGHT AND MAINTENANCE CONTROL:

VISUAL INSPECTION, SERVICEABILITY CONTROL, DOCKING WITH CALIBRATING DOCKING MECHANISM.

MAINTAINABILITY

REPAIR METHOD - REPLACEMENT.

REFERENCE DOCUMENTS: 33U.5319.027
33U.6271.011-09 ("SOFT")

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

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BM024-X

33U.6271.011-05 (PMA1)

33U.6201.008-08 (PMA2/3)

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: M8-1SS-BM024-03

REVISION# 2 JAN, 1997

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

CRITICALITY OF THIS
FAILURE MODE: 2/2

FAILURE MODE:
PLUNGER JAMS IN EXTENDED POSITION

MISSION PHASE:
OO ON-ORBIT

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

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)? 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:
PHYSICAL OBSERVATION - ORBITER/PMA1 DOCKING RING CANNOT CAPTURE TO ISS
(PMA2/FGB) MECHANISM BODY MOUNTED LATCH.

REMARKS/RECOMMENDATIONS:
THE PROBABILITY OF A CAPTURE SENSOR PLUNGER JAMMING IN THE EXTENDED
POSITION IS CONSIDERED VERY REMOTE. MISALIGNMENT OF THE ROD IS NOT
POSSIBLE BY DESIGN. ANY INCREASE IN RESISTANCE WOULD MOST LIKELY BE
OVERCOME BY THE POWER OF THE DOCKING MECHANISM DURING CAPTURE.

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- FAILURE EFFECTS -

(A) SUBSYSTEM:

INABILITY OF SENSOR TO DEPRESS WHEN IN CONTACT WITH ISS (PMA2/FG8) DOCKING MECHANISM WILL PREVENT AFFECTED CAPTURE LATCH FROM ENGAGING OPPOSING ISS MECHANISM BODY MOUNTED LATCH. MATING OF THE TWO DOCKING MECHANISMS FOR CLOSING STRUCTURAL HOOKS WOULD BE IMPAIRED.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT ON INTERFACING SUBSYSTEMS.

(C) MISSION:

WORST CASE, LOSS OF DOCKING CAPABILITIES RESULTING IN LOSS MISSION OBJECTIVES FOLLOWING A FAILURE TO ENGAGE A SINGLE CAPTURE LATCH.

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

NO EFFECT ON CREW OR VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

N/A

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: MINUTES TO HOURS

TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS

TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: N/A

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

N/A

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:

THERE IS NO CORRECTIVE ACTION TO RECOVER FROM A CAPTURE SENSOR WHOSE PLUNGER IS STUCK IN THE EXTENDED POSITION.

HAZARDS REPORT NUMBER(S): NONE

HAZARD(S) DESCRIPTION:

N/A

-DISPOSITION RATIONALE-

(A) DESIGN:

DESIGN OF THE SENSOR, SELECTION OF MATERIALS, AND SMALL ELECTRICAL LOADS REDUCE THE FAILURE PROBABILITY OF BOTH CONTACTS. DESIGN OF THE CONTACT

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PAIR (DUAL CHANNEL) HAS PASSED MAGNITUDES OF GROUND FUNCTIONAL TESTING AND MULTIPLE USES DURING PILOTED VEHICLE OPERATIONS IN SPACE. SPRING WHICH RETURNS THE INTERNAL ROD TO THE INITIAL POSITION IS DESIGNED TO OPERATE BEYOND LIMITS OF FATIGUE AND THUS, POSSIBILITY OF SPRING FAILURE IS VERY LOW. MISALIGNMENT OF THE ROD IS NOT POSSIBLE BY DESIGN. SENSOR IS COMPLETELY ENCASED TO PREVENT THE SIZE OF CONTAMINATION NECESSARY TO CAUSE THE PLUNGER TO JAM IN THE EXTENDED POSITION.

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

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 - TURNAOUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

ALL INCOMING PARTS ARE SUBJECTED TO EXTERIOR INSPECTION.

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

HEAT TREATING, SOLDERING, CHEMICAL PLATING, AND CURING VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

ASSEMBLY/INSTALLATION VERIFIED BY INSPECTION.

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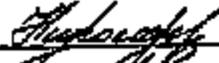
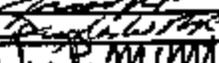
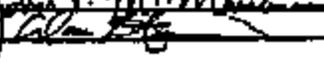
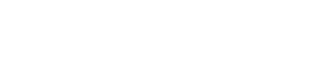
TESTING
ATP/QTP/OMRSD TESTING VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PROPER PACKAGING, STORAGE, AND TRANSPORTATION 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

- APPROVALS -

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