

PAGE: 190

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FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE

**NUMBER: M8-1SS-BM008-X
(DOESN'T APPLY TO PMA2/3
PASSIVE MECHANISM)**

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 1 DEC, 1986

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: MECH, GUIDE RING BALLSCREW	33U.6365.011-09 ("SOFT" MECHANISM)
	RSC-ENERGIA	33U.6365.011-05 (PMA1 MECHANISM)
SRU	: FIXER	33Y.6662.003
	RSC-ENERGIA	33Y.6662.003

PART DATA

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
GUIDE RING BALLSCREW INTERCONNECTING MECHANISM FIXER**

REFERENCE DESIGNATORS:

**QUANTITY OF LIKE ITEMS: 3
THREE (ONE PER BALLSCREW PAIR)**

FUNCTION:

CONTAINED WITHIN EACH BALLSCREW INTERCONNECTING MECHANISM, THE FIXER LOCKS OR UNLOCKS BOTH RODS OF A SINGLE BALLSCREW PAIR. WHEN POWER IS APPLIED TO THE FIXER, A MAGNETIC FIELD IS CREATED THAT EXTENDS A LEVER TO ENGAGE A GEAR WHICH MECHANICALLY LOCKS BOTH BALLSCREW RODS OF A SINGLE PAIR BY LIMITING THEIR ROTATION. THIS ACTION PREVENTS ROLL AND TRANSLATION MOVEMENT OF THE DOCKING RING AT ONE OF THREE POINTS AROUND THE RING. WHEN POWER IS REMOVED FROM THE WINDINGS OF THE FIXER, A SPRING RETRACTS THE LEVER (THAT LOCKS THE MECHANICAL GEAR LINK BETWEEN THE RODS) AND ALLOWS BOTH RODS OF THE BALLSCREW PAIR TO ROTATE.

SERVICE IN BETWEEN FLIGHT AND MAINTENANCE CONTROL:

SERVICEABILITY CONTROL, DOCKING WITH CALIBRATING DOCKING MECHANISM.

MAINTAINABILITY

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

REFERENCE DOCUMENTS: 33U.6365.011-09 ("SOFT" MECH.)
33U.6365.011-09 (PMA1 MECH.)
33U.6662.003

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

NUMBER: M8-1SS-BM008- 01
 (DOESN'T APPLY TO PMA2/3
 PASSIVE MECHANISM)

REVISION# 1 DEC, 1996

SUBSYSTEM NAME: MECHANICAL - EDS
 LRU: BALLSCREW INTERCONNECTING MECHANISM
 ITEM NAME: FIXER, RING

CRITICALITY OF THIS
 FAILURE MODE: 2R3

FAILURE MODE:
 FAILS TO LOCK

MISSION PHASE:
 OO ON-ORBIT

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

CAUSE:

STRUCTURAL FAILURE DUE TO MECHANICAL/THERMAL SHOCK OR MANUFACTURE/
 MATERIAL DEFECT, OPEN WINDINGS, SHORT BETWEEN WINDINGS; MECHANICAL
 JAMMING DUE TO CONTAMINATION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

REDUNDANCY SCREEN A) PASS
 B) FAIL
 C) PASS

PASS/FAIL RATIONALE:

A)

B)

FAILS REDUNDANCY SCREEN "B" SINCE A SINGLE FIXER FAILING TO LOCK
 (MECHANICALLY) IS NOT DETECTABLE IN FLIGHT.

C)

METHOD OF FAULT DETECTION:

SENSORS WILL MONITOR POWER TO ALL FIXERS AND PROVIDE THE INFORMATION FOR
 GROUND MONITORING THROUGH TELEMETRY DATA. FLIGHT CREW WOULD NOT BE
 ABLE TO DETECT A SINGLE FIXER FAILING TO LOCK. HOWEVER, VISUAL OBSERVATION
 OF THE DOCKING PROCESS MAY DETECT THE EFFECT OF A FAILURE TO LOCK ALL
 THREE FIXERS.

REMARKS/RECOMMENDATIONS:

THE RING (BALLSCREW INTERCONNECT MECHANISM) FIXER ALLOWS FOR ROLL AND
 TRANSLATION MOVEMENT OF THE RING ONLY. REDUNDANT WINDINGS, POWERED BY
 SEPARATE SOURCES, ARE PROVIDED FOR LOCKING OF FIXER.

- FAILURE EFFECTS -

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE**NUMBER: M8-1SS-BM008-01
(DOESNT APPLY TO PMA2/3
PASSIVE MECHANISM)****(A) SUBSYSTEM:**

FAILS TO PREVENT RELATIVE ROTATION OF AFFECTED RODS OF ONE BALLSCREW PAIR WHEN REQUIRED. FIRST FIXER FAILURE - LOSS OF CAPABILITY TO LIMIT ROLL AND TRANSLATION MOVEMENT AT ONE POINT ON THE DOCKING RING. NO EFFECT SINCE THIS MOVEMENT OF THE ENTIRE RING IS RESTRICTED BY THE REMAINING TWO RING FIXERS. SECOND FIXER FAILURE - LOSS OF CAPABILITY TO LIMIT ROLL AND TRANSLATION MOVEMENT AT SECOND POINT ON THE DOCKING RING. RING ALIGNMENT IS DIFFICULT BUT NOT IMPOSSIBLE SINCE REMAINING RING FIXER HELPS RESTRICT ROLL AND TRANSLATION MOVEMENT OF THE RING. THIRD FIXER FAILURE - WORST CASE. LOSS OF CAPABILITY TO ALIGN THE DOCKING RING IN THE ROLL AND TRANSLATIONAL DIRECTIONS.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT ON INTERFACING SUBSYSTEMS.

(C) MISSION:

POTENTIAL LOSS OF DOCKING FOLLOWING THIRD FIXER FAILING TO LOCK.

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

NO EFFECT ON CREW AND VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

FIRST FIXER FAILURE - NO EFFECT.

SECOND FIXER FAILURE - RING ALIGNMENT IN THE ROLL AND TRANSLATIONAL DIRECTION DIFFICULT BUT NOT IMPOSSIBLE.

THIRD FIXER FAILURE - WORST CASE, ALIGNMENT CANNOT BE MAINTAINED DURING RING RETRACTION IN THE ROLL AND TRANSLATIONAL DIRECTIONS FOR MATING AND STRUCTURAL LATCHING OF THE INTERFACE. LOSS OF CAPABILITY TO PERFORM DOCKING RESULTING IN LOSS OF MISSION OBJECTIVES.

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: HOURS TO DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS TO MINUTES

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 A FAILURE TO LOCK ALL THREE FIXERS.

HAZARDS REPORT NUMBER(S): NONE

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE**NUMBER: M8-155-BM006-01
(DOESN'T APPLY TO PMA2/3
PASSIVE MECHANISM)****HAZARD(S) DESCRIPTION:**
N/A

-DISPOSITION RATIONALE-

(A) DESIGN:

THE BALLSCREW INTERCONNECTING MECHANISM FIXER ALLOWS FOR ROLL AND TRANSLATION MOVEMENT OF THE RING ONLY. REDUNDANT WINDINGS, POWERED BY SEPARATE SOURCES, ARE PROVIDED FOR LOCKING OF FIXERS. INTERCONNECTING MECHANISM IS COMPLETELY ENCASED TO PREVENT THE INTRODUCTION OF CONTAMINATION LARGE ENOUGH TO CAUSE THE FIXER TO JAM IN THE UNLOCKED 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. ELECTRICAL CIRCUIT VERIFICATION TEST
2. INSULATION ELECTRICAL RESISTANCE TEST
3. FIXER FUNCTIONAL PERFORMANCE TEST
4. RETRACTION FORCE LOADS TEST
5. VIBRATION TEST
6. THERMAL VACUUM TEST

DOCKING MECHANISM QUALIFICATION TESTS:

1. ELECTRICAL CIRCUIT VERIFICATION TEST
2. INSULATION ELECTRICAL RESISTANCE TEST
3. TRANSPORTABILITY STRENGTH TEST
4. VIBRATION TEST
5. SHOCK-BASIC DESIGN TEST
6. THERMAL VACUUM TEST
7. SIX-DEGREE-OF-FREEDOM TEST
8. SERVICE LIFE TEST
9. FIXER LIMIT LOAD TEST
10. FIXER ULTIMATE LOAD TEST
11. 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

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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.

(E) OPERATIONAL USE:
 NONE. LOCKED FIXER ON THE REMAINING TWO INTERCONNECTING MECHANISMS WILL RESTRICT ROLL AND TRANSLATION MOVEMENT OF THE RING. ALIGNMENT MAY BE LOST FOLLOWING FAILURE OF ALL THREE FIXERS. HOWEVER THE CENTERING SPRINGS AND DOCKING MECHANISM HYSTERESIS WILL DAMP OUT RELATIVE MOVEMENT OF THE RING AND HELP KEEP RING ALIGNED. THIS ASSUMES THAT NO RING OSCILLATIONS EXIST PRIOR TO RETRACTING RING FROM IT'S FWD POSITION.

- APPROVALS -

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[Handwritten signatures and initials over the approval lines]