

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: M8-1SS-BM012-X
(APPLIES ONLY TO THE "SOFT"
MECHANISM)

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 2 JUN.1999

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: ASSY, LOW LEVEL DIFFERENTIAL RSC-ENERGIA	33U.6321.005 33U.6321.005
SRU	: LOCKING DEVICE RSC-ENERGIA	33U.6635.054 33U.6635.054

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
LOW TORQUE AXIAL SLIP CLUTCH LOCKING DEVICE SENSOR

REFERENCE DESIGNATORS: SQ7

QUANTITY OF LIKE ITEMS: 1
ONE

FUNCTION:

THE LOW TORQUE AXIAL SLIP CLUTCH LOCKING DEVICE LOCKS AND UNLOCKS THE LOW TORQUE AXIAL SLIP CLUTCH FROM THE RING KINEMATIC CHAIN. FOLLOWING RING EXTENSION TO THE RING INITIAL POSITION, POWER IS APPLIED TO THE LOW TORQUE LOCKING DEVICE ACTUATOR MOTORS TO UNLOCK THE LOW TORQUE SLIP CLUTCH, ALLOWING RING COMPLIANCE FOR DOCKING CONTACT. UPON AN EXTENDING OR RETRACTING COMMAND TO THE DOCKING RING FOLLOWING DOCKING CONTACT, POLARITY OF THE POWER TO THE LOCKING ACTUATOR MOTORS IS REVERSED TO LOCK THE LOW TORQUE SLIP CLUTCH. TORQUE FROM THE RING DRIVE ACTUATORS IS TRANSFERRED TO THE RING DRIVE KINEMATIC, AND NOT TO THE LOW TORQUE SLIP CLUTCH. THE LOCKING ACTUATOR IS AUTOMATICALLY CONTROLLED BY THE DSCU WITH RING INITIAL POSITION SENSORS AND SLIP CLUTCH LOCKING DEVICE SENSOR FEEDBACK.

A SENSOR ASSEMBLY CONTAINING SIX CONTACTS IS LOCATED WITHIN THE LOW TORQUE SLIP CLUTCH LOCKING ACTUATOR. REDUNDANT LOCK (ENGAGED) SENSOR CONTACTS PROVIDE INDICATION TO THE DSCU THAT THE SLIP CLUTCH IS IN THE "HARD" MODE. REDUNDANT UNLOCK (DISENGAGED) SENSOR CONTACTS PROVIDE INDICATION TO THE DSCU THAT THE SLIP CLUTCH IS IN THE "SOFT" MODE. THE REMAINING TWO CONTACTS ARE PROVIDED FOR MONITORING PURPOSES.

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.6321.005
33U.6635.054

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FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE

**NUMBER: M8-1SS-BM012-02
(APPLIES ONLY TO THE "SOFT"
MECHANISM)**

REVISION# 1 JAN,1997

**SUBSYSTEM NAME: MECHANICAL - EDS
LRU: LOW LEVEL DIFFERENTIAL ASSEMBLY
ITEM NAME: DEVICE, AXIAL SLIP CLUTCH LOCKING**

**CRITICALITY OF THIS
FAILURE MODE: 2/2**

**FAILURE MODE:
FAILS TO UNLOCK**

**MISSION PHASE:
OO ON-ORBIT**

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

**CAUSE:
MULTIPLE SPRING FAILURES DUE TO MECHANICAL/THERMAL SHOCK OR
MANUFACTURE/MATERIAL DEFECT, JAMMED ROD DUE TO CONTAMINATION**

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:

**INSTRUMENTATION - SENSORS LOCATED ON LOCKING ACTUATOR WILL DOWNLINK
STATUS OF SLIP CLUTCH TO GROUND STATION. FLIGHT CREW WOULD NOT BE ABLE TO
DETECT A LOCKED LOCKING DEVICE UNTIL SECOND DOCKING. AT WHICH TIME THE
FAILURE COULD BE DETECTED THROUGH VISUAL OBSERVATION - HIGHER THAN
NORMAL DOCKING LOADS DURING CAPTURE.**

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REMARKS/RECOMMENDATIONS:

LOCKING DEVICE IS MANUALLY CONTROLLED BY A SWITCH ON THE DOCKING CONTROL PANEL. IT IS UTILIZED TO LOCK OUT THE LOW LEVEL SLIP CLUTCH DURING MATING AND STRUCTURALLY LATCHING OF THE DOCKING MECHANISM INTERFACE.

- FAILURE EFFECTS -

(A) SUBSYSTEM:

NONE DURING INITIAL DOCKING. DURING SUBSEQUENT DOCKINGS, DOCKING LOADS ARE ABSORBED BY THE EXTEND/RETRACT ACTUATOR FRICTIONAL BRAKE INSTEAD OF THE LOW LEVEL SLIP CLUTCH DURING CAPTURE. LOSS OF DOCKING CAPABILITIES.

(B) INTERFACING SUBSYSTEM(S):

NONE DURING INITIAL DOCKING. LOADS WILL BE HIGHER THAN NORMAL DURING SECOND DOCKING.

(C) MISSION:

NO EFFECT ON INITIAL DOCKING. POTENTIAL DAMAGE TO SPACE STATION, DURING SECOND DOCKING, COULD RESULT IN LOSS OF MISSION.

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

NO EFFECT ON CREW AND VEHICLE. HOWEVER, HIGHER DOCKING LOADS COULD POTENTIALLY DAMAGE SPACE STATION ELEMENTS.

(E) FUNCTIONAL CRITICALITY EFFECTS:

N/A

DESIGN CRITICALITY (PRIOR TO OPERATIONAL DOWNGRADE, DESCRIBED IN F): 2/2

(F) RATIONALE FOR CRITICALITY CATEGORY DOWNGRADE:

NONE. THERE ARE NO WORKAROUNDS TO CIRCUMVENT THIS FAILURE.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: DAYS

TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: N/A

IS TIME REQUIRED TO IMPLEMENT CORRECTIVE ACTION LESS THAN TIME TO EFFECT?
NO

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:

THIS FAILURE IS NOT DETECTED UNTIL AFTER DOCKING AND THERE IS NO CORRECTIVE ACTION.

HAZARDS REPORT NUMBER(S): NONE

HAZARD(S) DESCRIPTION:

N/A

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-DISPOSITION RATIONALE-

(A) DESIGN:

THE LOCKING DEVICE ALLOWS DOCKING LOADS TO BE ABSORBED EITHER BY THE LOW LEVEL SLIP CLUTCH OR THE EXTEND/RETRACT ACTUATOR FRICTIONAL BRAKE. REDUNDANT MOTORS, POWERED BY SEPARATE SOURCES, ARE PROVIDED FOR LOCKING OF THIS DEVICE. SINCE THIS LOCKING DEVICE IS ELECTRICALLY ACTUATED, A FAILURE TO LOCK WOULD MOST LIKELY OCCUR DUE TO AN ELECTRICAL FAILURE RATHER THAN A MECHANICAL ONE. THE LOCKING DEVICE IS COMPLETELY ENCASED TO PREVENT THE INTRODUCTION OF CONTAMINATION LARGE ENOUGH TO CAUSE THE LOCKING DEVICE 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. STRUCTURAL HOOK PERFORMANCE TEST
4. VIBRATION TEST
5. 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. STRUCTURAL HOOK SIMULTANEOUS LOADS TEST
8. STRUCTURAL HOOK COMPONENT LOADS TEST
9. 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 OPERATIONS OF THE TECHNOLOGICAL PROCESS WHICH PROVIDES CLEANLINESS ARE VERIFIED BY INSPECTION.

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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

- APPROVALS -

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