

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: MO-AD1-M04-X

SUBSYSTEM NAME: REMOTELY OPERATED ELECTRICAL UMBILICAL

REVISION : 1 02/11/91

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ SRU :	CENTERING MECHANISM	V751-544200

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
CENTERING MECHANISM - ANGULAR

■ QUANTITY OF LIKE ITEMS: 1  
ONE PER ODA  
ONE ODA PER UMBILICAL

■ FUNCTION:  
THREE SPRING LOADED PLUNGERS PROVIDE THE ORBITER DISCONNECT ASSEMBLY  
WITH (5.5 DEGREE HALF CONE ANGLE) ANGULAR COMPLIANCE ABOUT THE Y/O AXIS  
OF THE ASSEMBLY.

PAGE: 2

PRINT DATE: 02/12/91

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE  
NUMBER: MO-AD1-M04-01

REVISION# 1 02/11/91 R  
SUBSYSTEM: REMOTELY OPERATED ELECTRICAL UMBILICAL  
ITEM NAME: CENTERING MECHANISM  
CRITICALITY OF THIS FAILURE MODE: 2/2

---

■ FAILURE MODE:  
PHYSICAL BINDING/JAMMING

MISSION PHASE:  
00 ON-ORBIT

■ VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA  
: 103 DISCOVERY  
: 104 ATLANTIS  
: 105 ENDEAVOUR

■ CAUSE:  
ADVERSE TOLERANCES/WEAR, CONTAMINATION/FOREIGN OBJECT/DEBRIS, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, THERMAL DISTORTION, VIBRATION

■ CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

---

■ REDUNDANCY SCREEN A) N/A  
■ B) N/A  
■ C) N/A

PASS/FAIL RATIONALE:  
■ A)

■ B)

■ C)

---

---

- FAILURE EFFECTS -

---

■ (A) SUBSYSTEM:  
LOSS OF FREEDOM OF MOVEMENT DURING THE MATE OPERATION AND LOSS OF STRESS RELIEF AFTER BEING MATED.

■ (B) INTERFACING SUBSYSTEM(S):  
LOSS OF NORMAL MATE/DEMATE OPERATION DURING PAYLOAD RETRIEVAL.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE  
NUMBER: MO-AD1-M04-01

- (C) MISSION:  
LOSS OF MISSION OBJECTIVE
- (D) CREW, VEHICLE, AND ELEMENT(S):  
NO EFFECT
- (E) FUNCTIONAL CRITICALITY EFFECTS:  
THE EFFECT WOULD BE LOSS OF ANGULAR ALIGNMENT CAPABILITY WHICH WOULD REQUIRE AN EVA WORK AROUND TO MATE/DEMATE CONNECTOR HALVES.

-----  
- DISPOSITION RATIONALE -  
-----

- (A) DESIGN:  
SIMPLE SPRING-LOADED MECHANISM THREE SIMPLE SPRING-LOADED PLUNGERS EQUALLY SPACED AROUND THE ODM TO PROVIDE CENTERING CAPABILITY.  
  
ALL THE MECHANISM MATERIALS HAVE BEEN CHOSEN FOR HIGH STRENGTH/LOW WEAR CHARACTERISTICS. MECHANISM DESIGNED WITH POSITIVE MARGINS OF SAFETY FOR WORSE CASE THERMAL CONDITIONS. ALIGNMENT MECHANISM DESIGNED TO ENSURE PROPER CAPTURE ENVELOPE FOR WORSE CASE THERMAL CONDITIONS. DESIGN OF THE ACTUATION SYSTEM PERMITS PARTIAL WORKAROUND BY CREW EVA ACTIONS.
- (B) TEST:  
QUALIFICATION:  
THE ROEU MECHANISM IS CERTIFIED PER CR 60-544100-001-C. SYSTEM QUALIFICATION TESTS INCLUDED:
  - \* VISUAL EXAMINATION TO VERIFY CONFORMANCE TO DRAWINGS, IDENTIFICATION MARKINGS, AND CLEANLINESS.
  - \* ENVIRONMENTAL TESTS - VIBRATION (BOOST) FOR 60 SEC/AXIS. FLIGHT VIBRATION FOR 140 SEC/AXIS. FIVE THERMAL/VACUUM CYCLES WITH SIMULATED ROEU/PAYLOAD DISPLACEMENTS.
  - \* OPERATIONAL LIFE TESTS - 84 CYCLES ON ARM AND LATCH MECHANISM.
  - \* QUALIFICATION ACCEPTANCE TESTS TO CERTIFY MECHANISM FOR FIVE ACCEPTANCE THERMAL AND FIVE ACCEPTANCE VIBRATION TESTS.
  - \* MAXIMUM DISPLACEMENT TESTS TO VERIFY OPERATIONAL ENVELOPE.
  - \* LIMIT, LIMIT PLUS LOADS TESTS TO VERIFY STATIC LOADING.
  - \* ARM AND LATCH STALL LOAD TESTS.
- ACCEPTANCE:  
THE ARM AND LATCH MECHANISMS WERE RIGGED PER CONTROLLED SPECIFICATION MLD308-0185, PLUS:
  - \* ACCEPTANCE VIBRATION RANDOM SPECTRUM 3 MIN/AXIS.
  - \* ACCEPTANCE THERMAL ONE AND ONE-HALF THERMAL CYCLES.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE  
NUMBER: MO-AD1-M04-01**

CERTIFICATION BY ANALYSIS/SIMILARITY:  
FACTORS INCLUDE: HUMIDITY, FUNGUS, OZONE, SALTSpray, SAND/DUST,  
ACCELERATION, FACTORS OF SAFETY, HAIL, LIGHTNING, RAIN, SOLAR RADIATION  
(THERMAL AND NUCLEAR), STORAGE/OPERATING LIFE, METEORIODS, ACOUSTICS,  
AND EXPLOSIVE ATMOSPHERE.

GROUND TURNAROUND:  
THE ROEU IS USED AS PAYLOAD INTEGRATION HARDWARE FOR DESIGNATED  
PAYLOADS ONLY. THE ROEU IS CANDIDATE EQUIPMENT FOR ALL VEHICLES AND  
FOR ALL FLIGHTS AND AS SUCH IS EVALUATED DURING GROUND TURNAROUND WHEN  
REQUIRED. THIS EVALUATION INCLUDES VISUAL INSPECTION FOR EVIDENCE OF  
UNUSUAL OPERATION AND A COMPLETE FUNCTIONAL CHECK.

**(C) INSPECTION:**

RECEIVING INSPECTION  
MATERIAL AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL  
INSPECTION VERIFIES CLEANLINESS IS MAINTAINED. INSPECTION VERIFIES  
CORROSION PROTECTION PER MA0608-301.

ASSEMBLY/INSTALLATION  
DIMENSIONS OF DETAIL PARTS VERIFIED BY INSPECTION. FASTENER  
INSTALLATION IS VERIFIED BY INSPECTION. ASSEMBLY AND RIGGING OF  
CENTERING MECHANISM IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION  
PENETRANT INSPECTION OF DETAIL PARTS IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES  
APPLICATION OF LB0140-005 DRY FILM LUBRICANT PER MA0112-302 IS VERIFIED  
BY INSPECTION. HEAT TREATING IS VERIFIED BY INSPECTION.

TESTING  
ACCEPTANCE TESTING OF THE CENTERING MECHANISM ASSEMBLY PRIOR TO  
DELIVERY IS VERIFIED BY INSPECTION PER APPLICABLE PROCEDURES.

HANDLING/PACKAGING  
HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

**(D) FAILURE HISTORY:**

NO FAILURE HISTORY IN THIS FAILURE MODE. FIRST USAGE OF MECHANISM OF  
THIS TYPE.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE  
NUMBER: MO-AD1-MO4-01

- (E) OPERATIONAL USE:  
PERFORM EVA TO MANUALLY AID CENTERING TO ALIGN AND MATE THE CONNECTOR HALVES.

-----  
- APPROVALS -  
-----

RELIABILITY ENGINEERING:	M. P. RAGUSA	<i>M.P. Ragusa</i>
DESIGN ENGINEERING :	G. CAMPBELL	<i>G. Campbell</i>
QUALITY ENGINEERING :	M. F. MERGEN	<i>M.F. Mergen</i>
NASA RELIABILITY :		
NASA SUBSYSTEM MANAGER :		
NASA QUALITY ASSURANCE :		<i>R.O. Dammert</i>

*6/12/91*