PRINT DATE: 02/12/91

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: MO-AD1-MO2-X

SUBSYSTEM NAME: REMOTELY OPERATED ELECTRICAL UMBILICAL
REVISION : 1 02/11/91

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ SRU :	X/O CENTERING MECHANISM,	V751-544300-001

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
X/O CENTERING MECHANISM, PAYLOAD DISCONNECT ASSEMBLY (PDA)

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

■ FUNCTION:
THE MECHANISM PROVIDES FREEDOM OF MOVEMENT FOR THE PAYLOAD MOUNTED CONNECTOR ALONG THE XO AXIS AS AN ALIGNMENT ACCOMMODATION DURING MATING WITH THE ORBITER CONNECTOR AND AS A STRESS RELIEF AFTER MATING IS COMPLETED.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: MO-AD1-MO2-01

SUBSYSTEM: REMOTELY OPERATED ELECTRICAL UMBILICAL
REVISION# I 02/11/91 R

ITEM NAME: X/O CENTERING MECHANISM,
CRITICALITY OF THIS FAILURE MODE:2/2

■ FAILURE MODE:
PHYSICAL BINDING/JAMMING

MISSION PHASE:
OO 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, BROKEN SPRING.

■ 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 FOR ALIGNMENT ALONG THE XO AXIS.

■ (B) INTERFACING SUBSYSTEM(S):
LOSS OF ABILITY TO MATE CONNECTORS. STRESSES ALONG THE XO AXIS WOULD

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: MO-AD1-M02-01

NOT BE RELIEVED, IF CONNECTORS ARE MATED.

- (C) MISSION:
LOSS OF MISSION OBJECTIVE. RETRIEVED PAYLOAD COULD NOT BE ELECTRICALLY CONNECTED OR DISCONNECTED.

- (D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT.

- (E) FUNCTIONAL CRITICALITY EFFECTS:
RETRIEVED PAYLOAD CAN NOT BE ELECTRICALLY CONNECTED OR DISCONNECTED. LOSS OF MISSION IF ELECTRICAL CONNECTION IS NECESSARY FOR MISSION SUCCESS.

- DISPOSITION RATIONALE -

- (A) DESIGN:
SIMPLE SPRING-LOADED MECHANISM WHICH TRANSLATES ALONG TWO SHAFTS AND GUIDED BY LINEAR BEARINGS IN THE X-AXIS. SAFETY FACTOR IS 1.4 MINIMUM ALL COMPONENTS SHOW POSITIVE MARGINS BY ANALYSIS.

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 - 6 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 ML0308-0185, PLUS:

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE NUMBER: MO-AD1-M02-01

* ACCEPTANCE VIBRATION RANDOM SPECTRUM 3 MIN/AXIS.
* ACCEPTANCE THERMAL ONE AND ONE-HALF THERMAL CYCLES.

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, METEOROIDS, 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-M02-01

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

- APPROVALS -

RELIABILITY ENGINEERING: M. P. RAGUSA
DESIGN ENGINEERING : G. CAMPBELL
QUALITY ENGINEERING : M. F. MERGEN
NASA RELIABILITY :
NASA SUBSYSTEM MANAGER :
NASA QUALITY ASSURANCE :

6/12/91