

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: MO-AD1-M15-X

S050270
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SUBSYSTEM NAME: REMOTELY OPERATED ELECTRICAL UMBILICAL

REVISION : 1 02/11/91

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ SRU	: MECHANICAL LINKAGE COMPONENTS	V751-544153
■ SRU	: MECHANICAL LINKAGE COMPONENTS	V751-544201
■ SRU	: MECHANICAL LINKAGE COMPONENTS	V751-544204
■ SRU	: MECHANICAL LINKAGE COMPONENTS	V751-544209
■ SRU	: MECHANICAL LINKAGE COMPONENTS	V751-544221
■ SRU	: MECHANICAL LINKAGE COMPONENTS	V751-544223

 PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

■ QUANTITY OF LIKE ITEMS:
ONE PER ROEU ASSEMBLY

■ FUNCTION:

THIS ASSEMBLY OF MECHANICAL COMPONENTS TRANSFERS THE ROTATIONAL OUTPUT OF THE DUAL ELECTRIC MOTOR HOOK (LATCH) ACTUATOR INTO APPROPRIATE LINEAR MOTION TO MOVE THE LATCH HOOKS INTO AND OUT OF THEIR LATCHED POSITION.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: MO-AD1-M15-01

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

■ FAILURE MODE:
PHYSICAL BINDING/JAMMING OR FAILS FREE

MISSION PHASE:
00 ON-ORBIT

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

■ CAUSE:
ADVERSE TOLERANCE/WEAR, CONTAMINATION/FOREIGN OBJECT/DEBRIS, LOSS OF LUBRICANT, FAILURE/DEFLECTION OF INTERNAL PART, TEMPERATURE, FATIGUE, VIBRATION

■ CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:

■ A)
N/A
■ B)
N/A
■ C)
N/A

- FAILURE EFFECTS -

■ (A) SUBSYSTEM:
LOSS OF (HOOK) LATCH/UNLATCH FUNCTION.

■ (B) INTERFACING SUBSYSTEM(S):
ORBITER-TO-PAYLOAD CONNECTOR HALVES CANNOT BE DISCONNECTED/CONNECTED

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WHEN REQUIRED.

- (C) MISSION:
LOSS OF ROEU MISSION OBJECTIVE.
- (D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT.
- (E) FUNCTIONAL CRITICALITY EFFECTS:
THESE FAILURE EFFECTS RESULT IN LOSS OF CAPACITY REQUIRING EVA WORK-
AROUND TO MATE/DEMATE CONNECTOR HALVES.

- DISPOSITION RATIONALE -

- (A) DESIGN:
DESIGN FACTOR OF SAFETY IS 1.4 X LIMIT LOAD. ALL COMPONENTS SHOW POSITIVE MARGINS BY ANALYSIS. DESIGN PRECLUDES DAMAGE UNDER STALLED CONDITION. EMERGENCY EVA DISCONNECT IS PROVIDED TO MANUALLY OVERRIDE INOPERATIVE LINKAGE AS PART OF THE LATCH/UNLATCH MECHANISM.

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 LATCH SYSTEM PERMITS PARTIAL WORKAROUND BY CREW EVA ACTIONS.

- (B) TEST:
QUALIFICATION:
THE LATCH MECHANISM IS CERTIFIED PER CR 60-287-0057-0001. 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:

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- * 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, METEORIDS, 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 HOOK
LINKAGE COMPONENTS 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 HOOK LINKAGE COMPONENTS ASSEMBLY PRIOR TO
DELIVERY IS VERIFIED BY INSPECTION PER APPLICABLE PROCEDURE.

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

- (D) FAILURE HISTORY:
NONE

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- (E) OPERATIONAL USE:
CONDUCT EVA WORKAROUND TO MATE/DEMATE CONNECTOR HALVES.

- APPROVALS -

RELIABILITY ENGINEERING:	M. P. RAGUSA	<i>comp. 2/12/91</i>	<i>M.P. Ragusa</i>
DESIGN ENGINEERING :	G. CAMPBELL	<i>-na</i>	<i>G. Campbell</i>
QUALITY ENGINEERING :	M. F. MERGEN	<i>1/12/91</i>	<i>M.F. Mergen</i>
NASA RELIABILITY :		<i>GE</i>	<i>[Signature]</i>
NASA SUBSYSTEM MANAGER :			<i>[Signature]</i>
NASA QUALITY ASSURANCE :			<i>[Signature] 6/12/91</i>