

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: MO-AD1-M07-X

SUBSYSTEM NAME: REMOTELY OPERATED ELECTRICAL LMBILICAL

REVISION : 1 02/11/91

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ SRU :	LATCH ACTUATOR HOOVER ELECTRIC	MC287-0057-0001 17820-1

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
MOTOR DRIVEN GEARBOX

■ QUANTITY OF LIKE ITEMS: 2
ONE PER ROEU ASSEMBLY
17820-2 (ARM ACTUATOR) IS SIMILAR ITEM.

■ FUNCTION:
THE LATCH ACTUATOR USES REDUNDANT MOTORS DRIVING THROUGH A
DIFFERENTIAL/GEARBOX TO PROVIDE THE FORCE NECESSARY TO LATCH/UNLATCH
THE ORBITER TO PAYLOAD ELECTRICAL CONNECTOR HALVES.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: MO-AD1-M07-01

SUBSYSTEM: REMOTELY OPERATED ELECTRICAL UMBILICAL **REVISION#** 1 02/11/91 R
ITEM NAME: LATCH ACTUATOR **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, BROKEN PART, 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 MATE/DEMATE FUNCTION.
- **(B) INTERFACING SUBSYSTEM(S):**
PAYLOAD CANNOT BE DEPLOYED/RETRIEVED, AS APPLICABLE.
- **(C) MISSION:**
LOSS OF MISSION OBJECTIVE.

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- (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:
GEARBOX IS SEALED TO EXCLUDE CONTAMINATION. 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 GEARBOX AND
LATCH/UNLATCH DISCONNECT.

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 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
MLO308-0185, PLUS:

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

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NUMBER: MO-AD1-M07-01****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 ARE VERIFIED BY INSPECTION. ALL PURCHASED PART DATA PAKS ARE 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 GEARBOX IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PENETRANT INSPECTION OR MAGNETIC PARTICLE INSPECTION 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 GEAR BOX 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>MP 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 EPD&C RELIABILITY :		
NASA QUALITY ASSURANCE :		<i>RO Brent Gentry 6/12/91</i>