

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**NUMBER: M0-AD1-M13 -X****SUBSYSTEM NAME:** REMOTELY OPERATED ELECTRICAL UMBILICAL**REVISION:** 2 01/07/02**PART DATA**

PART NAME	PART NUMBER
VENDOR NAME	VENDOR NUMBER
SRU : ARM ACTUATOR	MC287-0057-0002
TELAIR (FORMERLY HOOVER ELECTRIC)	17820-2

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

MOTOR DRIVEN GEARBOX

REFERENCE DESIGNATORS:**QUANTITY OF LIKE ITEMS:** 2

ONE PER ROEU ASSEMBLY

17820-1 (LATCH ACTUATOR) IS A SIMILAR ITEM.

FUNCTION:

THE ARM ACTUATOR USES REDUNDANT MOTORS DRIVING THROUGH A DIFFERENTIAL/GEARBOX TO PROVIDE THE FORCE NECESSARY TO MOVE THE SWING ARM TO THE STOW, MATE, AND RELAX POSITIONS.

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SUBSYSTEM NAME: REMOTELY OPERATED ELECTRICAL UMBILICAL

LRU:

CRITICALITY OF THIS

ITEM NAME: ARM ACTUATOR

FAILURE MODE: 2R3

FAILURE MODE:

PHYSICAL BINDING/JAMMING, FAILS FREE

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, LOSS OF LUBRICANT, FAILURE/DEFLECTION OF INTERNAL PART, TEMPERATURE, FATIGUE, VIBRATION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

- A) PASS
- B) FAIL
- C) FAIL

PASS/FAIL RATIONALE:

- A)
Prelaunch Installation and Checkout
- B)
There is no specific in-flight instrumentation to signal gearbox condition
- C)
Loss of function due to single failure of the gearbox

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF DEPLOY/STOW/RELAX FUNCTIONS.

(B) INTERFACING SUBSYSTEM(S):

PAYLOAD CANNOT BE DEPLOYED/RETRIEVED, AS APPLICABLE.

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(C) MISSION:
LOSS OF MISSION OBJECTIVE.

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

(E) FUNCTIONAL CRITICALITY EFFECTS:
THESE FAILURE EFFECTS RESULT IN LOSS OF CAPABILITY REQUIRING EVA WORK-
AROUND TO PERFORM ARM DEPLOY/STOW/RELAX FUNCTIONS.

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

(F) RATIONALE FOR CRITICALITY DOWNGRADE:
CRITICALITY IS DOWNGRADED FROM THE DESIGN CRITICALITY, 2/2, TO 2R/3 DUE TO
CONSIDERATION OF THE EVA OPERATIONAL WORKAROUND CAPABILITY. WITH EVA
FEATURE THE CREW CAN MANUALLY DEPLOY/STOW/RELAX THE ARM.

-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 ROEU MECHANISM IS CERTIFIED PER CR 60-544100-001-C. SYSTEM QUALIFICATION
TESTS INCLUDED:
* VISUAL EXAMINATION TO VERIFY CONFORMANCE TO DRAWINGS,

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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 ML0308-0185, PLUS:

- * 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:

OMRSD - ANY TURNAROUND TEST CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDING WITH OMRSD

(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 THE ACTUATOR 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 ACTUATOR ASSEMBLY PRIOR TO DELIVERY IS VERIFIED BY INSPECTION PER APPLICABLE PROCEDURE.

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HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

FOR FAILURE HISTORY REFER TO DATA BANK FOR MC287-0020, -0041, -0037, - 0039, -0040, AND MC147-0013.

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURE, UNEXPLAINED ANOMALIES, AND OTHER FAILURE EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE

(E) OPERATIONAL USE:

CONDUCT EVA WORKAROUND TO PERFORM ARM DEPLOY/STOW/RELAX FUNCTIONS.

- APPROVALS -

S&R ENGINEER.	:A. NGUYEN	:/s/A. Nguyen _____
CARGO/INTEG ITM.	:J. CAPALENI	:/s/J. Capaleni _____
DESIGN ENGINEERING	:D. HAEHLKE	:/s/D. Haehlke _____
SSM	:P. REESE	:/s/P. Reese _____
MOD	:K. SMITH	:/s/K. Smith _____
USA/SAM	:R. SMITH	:/s/S.R. Smith _____
USA CARGO/INTG ELEMENT	:H. MALTBY	:/s/H. Maltby _____
USA ORBITER ELEMENT	:S. LITTLE	:/s/S. Little _____