

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: M0-AD1-M18 -X**

SUBSYSTEM NAME: REMOTELY OPERATED ELECTRICAL UMBILICAL (ROEU)
REVISION: 01/07/02

PART DATA

PART NAME	PART NUMBER
VENDOR NAME	VENDOR NUMBER
SRU :GEAR CAM, ODM LIMIT SWITCH ASSEMBLY (ARM DRIVE)	V751-544252

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
THE CAM GEAR IS A MULTI-FUNCTION DETAIL PART OF THE ARM DRIVE MECHANISM FOR THE ROEU SYSTEM. THE ELEMENT IS MACHINED FROM INCONEL BAR STOCK.

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 1
ONE PER ROEU ASSEMBLY

FUNCTION:
THE MULTI-FUNCTIONAL CAM GEAR PROVIDES THE INTERMEDIATE COUPLING BETWEEN THE OUTPUT OF THE ACTUATOR AND THE INPUT CRANK OF THE LINKAGE THAT DRIVES THE UMBILICAL ARM. THE CAM GEAR HOUSES THE BALL LOCK MECHANISM THAT CAN DECOUPLE THE ACTUATOR FROM OTHER PARTS OF THE DRIVE SYSTEM TO ALLOW MANUAL OPERATION OF THE MECHANISM. THE CAM SURFACES ADJACENT TO THE GEAR IS THE MECHANICAL INTERFACE FOR THE SWITCH MODULES THAT PROVIDE POSITION FEEDBACK AND MOTOR CUT-OFF SIGNAL FOR THE STOW, MATE, AND RELAX POSITIONS. THE CAM GEAR ALSO INCLUDES THE MECHANICAL STOPS, WHICH LIMIT THE TRAVEL OF THE MECHANISM IN THE EVENT OF LIMIT SWITCH FAILURE OR MANUAL OPERATION. IN ADDITION, THE CAM GEAR IS AN INTEGRAL PART OF THE GEAR TRAIN FOR THE MANUAL/EVA DRIVE INTERFACE

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SUBSYSTEM NAME: REMOTELY OPERATED ELECTRICAL UMBILICAL (ROEU)

LRU:

CRITICALITY OF THIS

ITEM NAME: ODM ARM DRIVE LIMIT SWITCH ASSEMBLY

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, 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)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF DEPLOY/STOW/RELAX FUNCTIONS.

(B) INTERFACING SUBSYSTEM(S):

PAYLOAD CANNOT BE DEPLOYED/MATED, AS APPLICABLE.

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(C) MISSION:
LOSS OF MISSION OBJECTIVE.

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

-DISPOSITION RATIONALE-

(A) DESIGN:
THE LIMIT SWITCH ASSEMBLY 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.

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.

(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 600 SEC/AXIS AND FLIGHT VIBRATION FOR 1400 SEC/AXIS BY THE ROFU QUALIFICATION TEST. FIVE THERMAL/VACUUM CYCLES WITH SIMULATED ROEU/PAYLOAD DISPLACEMENTS.
- * OPERATIONAL LIFE TESTS - 500 CYCLES, BY THE ROFU QUALIFICATION TEST, 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.

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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 PARTS 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

MATERIAL INTERGRITY VERIFIED BY NON DESTRUCTIVE EVALUATION.

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.

HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

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:

NONE

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- 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_____
NASA/DCE	:D. LADRACH	:/s/D. Ladrach_____
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_____