

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: M0-AD1-M14 -X

SUBSYSTEM NAME: REMOTELY OPERATED ELECTRICAL UMBILICAL

REVISION: 1 02/11/91

PART DATA

PART NAME	PART NUMBER
VENDOR NAME	VENDOR NUMBER
SRU : EVA BALL LOCK MECHANISM	V751-544170

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
 OVERRIDE MECHANISM - EVA ARM POSITIONING MECHANISM

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 2
 ONE PER ASSEMBLY
 ONE OPM PER UMBILICAL

FUNCTION:

PROVIDES CREW WITH EVA CAPABILITY TO OVERRIDE THE ACTUATOR AND MANUALLY DEPLOY, RELAX, OR STOW ARM. CREW CAN ACTIVATE THE MECHANISM BY LIFTING EVA OVERRIDE COVER WHICH ACTIVATES PLUNGER AND DISENGAGES MOTOR/GEARBOX OUTPUT; ENGAGE RATCHET, AND BY USING A 7/16 SOCKET WRENCH, TURN EVA DRIVE SHAFT TO TRANSMIT TORQUE TO REPOSITION MECHANISM. OVERRIDE MECHANISM INCORPORATES A RATCHET TO TRANSFER TORQUE IN ONE DIRECTION ONLY.

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NUMBER: M0-AD1-M14- 01

REVISION#: 2 01/07/02

SUBSYSTEM NAME: REMOTELY OPERATED ELECTRICAL UMBILICAL

LRU:

CRITICALITY OF THIS

ITEM NAME: EVA BALL LOCK MECHANISM

FAILURE MODE: 2R3

FAILURE MODE:

FAILS TO DISCONNECT MOTOR COUPLING FROM GEARBOX (EMERGENCY EVA OPERATION ONLY). FAILS TO DRIVE MECHANISM WHEN MANUALLY OPERATED.

MISSION PHASE: OO ON-ORBIT

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

CAUSE:

SPRING FAILURE, EXCESSIVE FRICTION, JAMMED COUPLING, BEARING, OR COVER, CONTAMINATION, DEBRIS, TOLERANCE VARIATION, SHEARED BOLT.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:

A)
FAILS REDANDANCY SCREEN "A" SINCE THERE IS NO VISUAL OR INSTRUMENTED WAY OF DETECTING A FAILURE OF THE EVA DRIVE ASSEMBLY ON GROUND

B)
STANDBY SYSTEM

C)
JAMMING OF EVA MECHANISM WOULD PREVENT THE MANUALLY DEPLOY/STOW/RELAX OPERATIONS OF THE ARM

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF EMERGENCY EVA CAPABILITY TO MANUALLY DEPLOY/STOW/RELAX THE ARM ASSEMBLY.

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(B) INTERFACING SUBSYSTEM(S):
SAME AS (A).

(C) MISSION:
LOSS OF MISSION OBJECTIVE.

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

(E) FUNCTIONAL CRITICALITY EFFECTS:
PRIOR FAILURE(S) ARE REQUIRED BEFORE USE OF OVERRIDE IS MANDATORY. FAILURE WHEN USE IS MANDATORY RESULTS IN LOSS OF MISSION OBJECTIVE.

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:
DESIGN IS PROTECTED BY COVER FROM FOREIGN OBJECTS OR DEBRIS. COVER PREVENTS PREMATURE/INADVERTENT USE OF EVA DISCONNECT, COUPLING FOR LATCH DRIVE CAN BE DISCONNECTED FROM GEARBOX BY LIFTING AND ROTATING COVER 120 DEG. DESIGN FACTOR OF SAFETY IS 1.4 X LIMIT LOAD. 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:

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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 - 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 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 BALL LOCK 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

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ACCEPTANCE TESTING OF THE BALL LOCK MECHANISM 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

- 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_____