

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 02-5E-L04 -X

SUBSYSTEM NAME: PAYLOAD RETEN & DEPLOY - LATCHES

REVISION: 4 01/17/01

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: LIGHTWEIGHT LONGERON LATCH	V073-544100
LRU	: MIDDLEWEIGHT LONGERON LATCH	V073-544230
LRU	: SUPER MIDDLE WT LONGERON LATCH	V073-544530
SRU	: EVA DRIVE	V073-544213

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

EVA DRIVE

QUANTITY OF LIKE ITEMS:

20 MAX

FUNCTION:

LIGHTWEIGHT, MIDDLEWEIGHT OR SUPER MIDDLEWEIGHT LONGERON LATCH INCORPORATES AN EXTRAVEHICULAR ACTIVITY (EVA) MECHANISM TO DISCONNECT THE LATCH LINKAGES FROM THE MOTOR GEARBOX AND MANUALLY DRIVE LATCH LINKAGES/HOOK OPEN OR CLOSED. THIS IS A FEATURE TO PERMIT MANUAL LATCH OPERATION TO BYPASS PREVIOUS FAILURES.

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LRU: LIGHT, MIDDLE, SUPER MIDDLE WT LONGERON LATCH

ITEM NAME: EVA DRIVE

CRITICALITY OF THIS
FAILURE MODE: 1R2

FAILURE MODE:

FAILS TO FUNCTION

MISSION PHASE:

OO ON-ORBIT
DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:

EXCESSIVE FRICTION, JAMMED MECHANISM, CONTAMINATION/FOREIGN OBJECT/ DEBRIS,
THREAD BINDING, SHEAR PIN WILL NOT SHEAR

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

A) FAIL
B) N/A
C) PASS

PASS/FAIL RATIONALE:

A)

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

B)

STANDBY REDUNDANCY

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

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FAILURE OF EVA MECHANISM AFTER PREVIOUS LATCH FAILURE (IN THE GEARBOX) WILL RESULT IN A LOSS OF ABILITY TO DISCONNECT GEARBOX DURING EVA AND DRIVE THE LATCH OPEN OR CLOSED.

(B) INTERFACING SUBSYSTEM(S):

FAILURE OF EVA MECHANISM AFTER PREVIOUS LATCH FAILURE (IN THE GEARBOX) WILL RESULT IN AN INABILITY TO EVA DRIVE THE LATCH TO EITHER CLOSED OR OPEN POSITION, AND UNRESTRAINED PAYLOAD IF THE LATCH WAS IN A PARTIALLY OPENED POSITION.

(C) MISSION:

FAILURE OF EVA MECHANISM AFTER PREVIOUS LATCH FAILURE (IN THE GEARBOX) WILL RESULT IN LOSS OF MISSION DUE TO INABILITY TO UNBERTH OR RESTRAIN PAYLOADS.

(D) CREW, VEHICLE, AND ELEMENT(S):

FAILURE OF EVA MECHANISM AFTER PREVIOUS LATCH FAILURE (IN THE GEARBOX) WILL RESULT IN LOSS OF CREW/VEHICLE DUE TO UNRESTRAINED PAYLOAD DURING ENTRY/LANDING. REQUIRES TWO FAILURES INCLUDING FAILURE OF THE EVA MECHANISM WITH THE EXCEPTION OF FAILURE IN THE LINKAGES OR HOOK.

(E) FUNCTIONAL CRITICALITY EFFECTS:

LOSS OF LATCH OPERATION IN MID-TRAVEL POSITION WOULD RESULT IN UNRESTRAINED PAYLOAD DURING ENTRY/LANDING, AND COULD RESULT IN LOSS OF VEHICLE AND CREW. REQUIRES FAILURE IN THE GEARBOX OR TWO MOTORS AND FAILURE OF EVA CAPABILITY.

-DISPOSITION RATIONALE-

(A) DESIGN:

EVA DISCONNECT CAN BE OPERATED MANUALLY WITH 35 LB FORCE ON 8 INCH HANDLE OF STANDARD 7/16 INCH SOCKET WRENCH. ALUMINUM SHEAR PIN PREVENTS PREMATURE ROTATION OF DISCONNECT SHAFT. BELLCRANK FOR LATCH DRIVE CAN BE DISCONNECTED FROM GEARBOX BY SHEARING PIN WITH 40 INCH-LB TORQUE AND ROTATING SHAFT 5 REVOLUTIONS IN RELEASE DIRECTION. ADDITIONAL 160 DEG. IN RELEASE DIRECTION OPENS LATCH. SLIP CLUTCH ALLOWS ROTATION OF SHAFT RELATIVE TO BELLCRANK DURING 0.31 INCH TRANSLATION OF SPLINE COUPLING. CLUTCH TRANSFERS TORQUE TO BELLCRANK IN CLOSING DIRECTION, ALLOWING MANUAL CLOSING OF LATCH. DESIGN FACTOR OF SAFETY IS 1.4 X LIMIT LOAD. ALL COMPONENTS SHOW POSITIVE MARGINS BY ANALYSIS.

(B) TEST:

ACCEPTANCE TESTS: THE FOLLOWING TESTS ARE PERFORMED FOR ALL FLIGHT ARTICLES AND WERE PERFORMED FOR EACH QUALIFICATION TEST ARTICLE: VIBRATION - RANGE 20

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TO 2,000 HZ MAXIMUM LEVEL OF 0.04 G2/HZ FROM 80 TO 350 HZ, ALL AXES. THERMAL - STABILIZED RANGE FROM -180 DEG F TO +255 DEG F. FUNCTIONAL TESTS CONDUCTED AT - 80 DEG F, +70 DEG F, AND +255 DEG F. LOADS/ALIGNMENT - VERIFY RETENTION OF LATCHED POSITION AT 80% LIMIT LOAD, AS WELL AS SPHERICAL BEARING TORQUE RESISTANCE AND TRAVEL LIMITS. ONE UNIT TESTED TO 110% LIMIT LOAD. ELECTRICAL - VERIFY (WITHIN DESIGN LIMITS) CONTINUITY, DIELECTRIC STRENGTH, INSULATION RESISTANCE, AND SWITCH OPERATION.

QUALIFICATION TESTS: THE FOLLOWING IS A SUMMARY OF TESTS CONDUCTED PER CR 44-544230-001 TO INCLUDE BOTH NATURAL AND INDUCED ENVIRONMENTAL EFFECTS TO THE LATCH ASSEMBLY AND THE LATCH-TO-BRIDGE/TRUNNION FRICTION /LOAD INTERFACE. FUNCTIONAL TESTS WERE CONDUCTED DURING AND FOLLOWING EACH PHASE OF TESTING TO DETERMINE EFFECTS. ENVIRONMENTS AND REQUIREMENTS ACCEPTED BY ANALYSIS INCLUDE FUNGUS, OZONE, SALT SPRAY, ACCELERATION, SOLAR RADIATION (THERMAL AND NUCLEAR), METEOROIDS, SAND AND DUST, STORAGE, FACTOR OF SAFETY, RELIABILITY, MAINTAINABILITY, MATERIALS AND PROCESSES, ELECTRICAL DESIGN AND SAFETY. CERTIFICATION BY SIMILARITY INCLUDED VACUUM, RANDOM VIBRATION, HANDLING SHOCK, THERMAL CYCLING, FULL OPERATING LIFE, QUALIFICATION ACCEPTANCE VIBRATION TEST (QAVT), QUALIFICATION ACCEPTANCE THERMAL TEST (QATT), TRUNNION/BRIDGE FRICTION, MECHANICAL STOPS, AND EXPLOSIVE ATMOSPHERE.

OMRSD: GROUND TURNAROUND INCLUDES SHEAR PIN VERIFICATION FOR LATCHES. ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

MATERIAL AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS REQUIREMENTS VERIFIED BY INSPECTION. CORROSION PROTECTION PER MAO608-301 VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

DIMENSIONS AND SURFACE FINISHES OF DETAIL PARTS, INCLUDING EXTERNAL AND INTERNAL SPLINE DATA, ARE VERIFIED BY INSPECTION. ASSEMBLY PER DETAILED DRAWING GENERAL NOTES ARE VERIFIED BY INSPECTION. THREADS PER MIL-S-8879 ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PENETRANT INSPECTION OF DETAIL PARTS PER MTO501-504 IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

HEAT TREATING IS VERIFIED BY INSPECTION. INSPECTION VERIFIES CERTIFICATIONS OF SHEAR PIN RAW MATERIAL CHEMISTRY AND ANNEALED CONDITION.

TESTING

ACCEPTANCE TESTING IS VERIFIED PER PROCEDURE.

HANDLING/PACKAGING

DOUBLE BAGGING AND SEALING FOR STORAGE IS VERIFIED BY INSPECTION.

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(D) FAILURE HISTORY:

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

(E) OPERATIONAL USE:

NONE.

- APPROVALS -

S&R ENGINEER	: T. T. AI	: <i>[Signature]</i> 2/26/01
S&R ENGINEERING ITM	: P. A. STENGER-NGUYEN	: <i>P.A. Stenger-Nguyen</i> 3/5/01
DESIGN ENGINEER	: D. E. HAEHLKE	: <i>Dan Haehlke</i> 2/26/01
SUBSYSTEM MANAGER	: P. REESE	: <i>[Signature]</i> 2/27/01
MOD	: D. B. LYLE	: <i>[Signature]</i> 3/20/01
USA SAM	: B. BOURGEOIS	: <i>Benjamin P. Bourgeois</i> 3/8/01
USA ORBITER ELEMENT	: S. LITTLE	: <i>Suzanne Little</i> 3/8/01