

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE  
NUMBER: 02-5E-MK01-X**

**SUBSYSTEM NAME: P/L RETENTION & DEPLOY - LATCHES**

**REVISION: 3 10/18/94**

	<b>PART NAME VENDOR NAME</b>	<b>PART NUMBER VENDOR NUMBER</b>
ASSEMBLY :	MIDDLEWEIGHT KEEL LATCH	V073-544430
LRU :	DRIVE MECHANISM	

**PART DATA**

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
DRIVE MECHANISM**

**QUANTITY OF LIKE ITEMS: 5**  
1 PER LATCH ASSEMBLY  
5 MAX PER VEHICLE

**FUNCTION:**

MIDDLEWEIGHT KEEL LATCH REACTS FLIGHT LOADS ON PAYLOAD VERTICAL TRUNNION HELD BETWEEN TWO SPHERICAL HALF BEARINGS. MOTORS ACT THROUGH A DIFFERENTIAL AND GEARBOX TO ACTUATE THE DRIVE LINKAGES, BALLSCREW AND SECONDARY FRAME. THERE IS NO TORQUE LIMITER IN THE LATCH.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE  
NUMBER: 02-5E-MK01-01**

**SUBSYSTEM NAME:** PAL RETENTION & DEPLOY - LATCHES  
**LRU:** MIDDLEWEIGHT KEEL LATCH  
**ITEM NAME:** DRIVE MECHANISM

**REVISION#** 3      **10/18/94**  
**CRITICALITY OF THIS  
FAILURE MODE:** 1/1

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**FAILURE MODE:**  
PHYSICAL BINDING/JAMMING

**MISSION PHASE:**  
OO            ON-ORBIT  
DO            DE-ORBIT

**VEHICLE/PAYLOAD/KIT EFFECTIVITY:**

102	COLUMBIA
103	DISCOVERY
104	ATLANTIS
105	ENDEAVOUR

**CAUSE:**  
ADVERSE TOLERANCES/WEAR, CONTAMINATION/FOREIGN OBJECT/DEBRIS, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, TEMPERATURE, VIBRATION

**CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO**

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**REDUNDANCY SCREEN**

A)	N/A
B)	N/A
C)	N/A

**PASS/FAIL RATIONALE:**

- A)
- B)
- C)

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**- FAILURE EFFECTS -**

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**(A) SUBSYSTEM:**

LOSS OF ABILITY TO DRIVE THE LATCH OPEN OR CLOSED.

**(B) INTERFACING SUBSYSTEM(S):**

INABILITY TO EITHER UNBERTH PAYLOADS (IF FAILED CLOSED) OR RESTRAIN PAYLOADS (IF FAILED OPEN OR PARTIALLY OPEN).

**(C) MISSION:**

POSSIBLE LOSS OF MISSION DUE TO INABILITY TO UNBERTH OR RESTRAIN PAYLOADS.

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

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POSSIBLE LOSS OF CREW/VEHICLE DUE TO UNRESTRAINED PAYLOAD DURING ENTRY.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

THE KEEL FRAME, GEARBOX, AND HOUSING ARE FABRICATED OF TITANIUM. LINKAGE HAS DUAL ROTATING SURFACES AT PIVOTS, LATCH WAS QUALIFIED TO ORBITER ENVIRONMENTS, BALL SCREW ASSEMBLY IS IDENTICAL TO ASSEMBLY USED IN PREVIOUSLY QUALIFIED LATCH, BALL SCREW ASSEMBLY HAS THREAD SEALS, ICE SCRAPER, SHIELDS AT EACH END OF BALL NUT, FACTOR OF SAFETY OF ALL COMPONENTS IS 1.4 OVER LIMIT LOADS, POSITIVE MARGINS ON ALL COMPONENTS SHOWN BY ANALYSIS, REDUNDANT ELECTRIC MOTORS PROVIDED, GEARBOX IS SEALED TO EXCLUDE CONTAMINATION.

**(B) TEST:**

ACCEPTANCE TESTS: THE FOLLOWING TESTS ARE PERFORMED FOR ALL FLIGHT ARTICLES AND WERE PERFORMED FOR EACH QUALIFICATION TEST ARTICLE: VIBRATION -- RANGE 20 TO 2,000 HZ MAXIMUM LEVEL OF 0.04 G<sup>2</sup>/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, AMBIENT 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. ELECTRICAL -- VERIFY (WITHIN DESIGN LIMITS) CONTINUITY, DIELECTRIC STRENGTH, INSULATION RESISTANCE, AND SWITCH OPERATION.

QUALIFICATION TESTS: QUALIFICATION IS BY SIMILARITY TO LIGHTWEIGHT KEEL LATCH (V073-544300). FIRST UNIT TESTED TO 100% LIMIT LOAD.

OMRSD: ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

**(C) INSPECTION:**

RECEIVING INSPECTION  
MATERIAL AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL  
INSPECTION VERIFIES CORROSION PROTECTION REQUIREMENTS PER MAO608-301.  
INSPECTION VERIFIES CLEANLINESS PER MAO110-311.

ASSEMBLY/INSTALLATION  
INSPECTION VERIFIES LATCH IS RIGGED PER MLO308-0202. INSPECTION VERIFIES DIMENSIONS OF DETAIL PARTS. INSPECTION VERIFIES FASTENER INSTALLATION PER MAO101-301.

NONDESTRUCTIVE EVALUATION  
INSPECTION VERIFIES PENETRANT INSPECTION OF DETAIL PARTS PER MTO501-508.

CRITICAL PROCESSES

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INSPECTION VERIFIES APPLICATION OF LBO140-005 DRY FILM LUBRICANT PER SPECIFICATION AND DRAWING REQUIREMENTS. INSPECTION VERIFIES HEAT TREAT OF INCONEL 718 FOR MAXIMUM CREEP RESISTANCE PER MAO111-303.

**TESTING**

INSPECTION VERIFIES ACCEPTANCE TEST OF THE LATCH ASSEMBLY PER MLO108-0221 PRIOR TO DELIVERY.

**HANDLING/PACKAGING**

HANDLING AND PACKAGING REQUIREMENTS VERIFIED BY INSPECTION.

**(D) FAILURE HISTORY:**

FAILURE HISTORY IS TRACKED IN THE PRACA SYSTEM.

**(E) OPERATIONAL USE:**

IF THE LATCH FAILS IN THE CLOSED POSITION, UNBERTH, DEPLOY, AND/OR JETTISON OF THE ASSOCIATED PAYLOAD MAY BE ATTEMPTED USING RMS OPERATIONS, BACKAWAY MANUEVERS, AND/OR EVA PROCEDURES TO PRECLUDE RETURN OF AN UNSECURED PAYLOAD.

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**- APPROVALS -**

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EDITORIALLY APPROVED : RI  
EDITORIALLY APPROVED : JSC  
TECHNICAL APPROVAL : VIA CR

*[Signature]*  
: *[Signature]* 10 25 94  
: S50270AP