

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE  
NUMBER: 02-5E-MK02-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 :	MOTOR/BRAKE ASSEMBLY	MC287-0054-0001 2960614-021
LRU :	MOTOR/BRAKE ASSEMBLY	MC287-0054-0002 2960614-021

**PART DATA**

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
MOTOR/BRAKE ASSEMBLY**

**QUANTITY OF LIKE ITEMS: 10  
2 PER LATCH ASSEMBLY  
10 MAX PER VEHICLE**

**FUNCTION:**

MIDDLEWEIGHT KEEL LATCH REACTS FLIGHT LOADS ON PAYLOAD VERTICAL TRUNNION HELD BETWEEN TWO SPHERICAL HALF BEARINGS. REDUNDANT MOTORS ACT THROUGH A DIFFERENTIAL AND GEARBOX TO DRIVE THE LINKAGES, BALLSCREW AND SECONDARY FRAME. THE MOTORS INCORPORATE INTEGRAL BRAKE MECHANISMS AND ARE CONTROLLED BY POSITION SWITCHES LOCATED WITHIN THE LATCH. TWO A/C PHASES ARE REQUIRED TO LIFT THE BRAKE AND POWER THE MOTOR. THERE ARE NO SINGLE FAILURE MODES WHICH WOULD ALLOW A FREE WHEELING MOTOR AFTER APPLICATION OF POWER.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE**  
**NUMBER: 02-5E-MK02-02**

**SUBSYSTEM NAME: P/L RETENTION & DEPLOY - LATCHES**  
**LRU: MIDDLEWEIGHT KEEL LATCH**  
**ITEM NAME: MOTOR/BRAKE ASSEMBLY**

**REVISION# 3      10/18/94**  
**CRITICALITY OF THIS FAILURE MODE: 1R2**

**FAILURE MODE:**  
**BRAKE FAILS TO ENGAGE**

**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, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, FAILURE/ DEFLECTION OF INTERNAL PART, ELECTRICAL FAILURE - OPEN, SHORT, ETC**

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

**REDUNDANCY SCREEN**

A) PASS
B) FAIL
C) PASS

**PASS/FAIL RATIONALE:**

**A)**

**B)**

**FAILS REDUNDANCY SCREEN 'B' SINCE THERE IS NO VISUAL OR INSTRUMENTED WAY OF DETECTING A FAILURE OF THE MOTOR/BRAKE ASSEMBLY IN FLIGHT.**

**C)**

**- FAILURE EFFECTS -**

**(A) SUBSYSTEM:**

**FIRST FAILURE - NONE. SECOND FAILURE - FAILURE OF ASSOCIATED MOTOR WILL ALLOW THE REDUNDANT MOTOR TO BACKDRIVE THROUGH THE FAILED BRAKE AND LATCH POSITIONING CAPABILITY WOULD BE LOST.**

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

**FIRST FAILURE - NONE. SECOND FAILURE - FAILURE OF ASSOCIATED MOTOR WILL RESULT IN LOSS OF ABILITY TO DRIVE LATCH.**

**(C) MISSION:**

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE  
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FIRST FAILURE - NONE. SECOND FAILURE - FAILURE OF ASSOCIATED MOTOR WILL RESULT IN A POSSIBLE LOSS OF MISSION DUE TO INABILITY TO RELEASE OR RESTRAIN PAYLOAD.

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

FIRST FAILURE - NONE. SECOND FAILURE - POSSIBLE LOSS OF CREW/VEHICLE DUE TO UNRESTRAINED PAYLOAD DURING ENTRY.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

NONE

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

THE KEEL FRAME, GEARBOX, AND HOUSING ARE FABRICATED OF TITANIUM. THE MOTOR HAS THE DESIGN REQUIREMENTS OF THREE PHASE, 400 HZ, AC INDUCTION MOTOR AND INTEGRAL BRAKE THAT WILL BE USED IN A SPACE ENVIRONMENT. THE MOTOR IS ENCLOSED WITH COVER TO EXCLUDE CONTAMINATION. IT HAS A FACTOR OF SAFETY OF 1.4 OVER LIMIT LOAD. MATERIAL AND PROCESS FOR THE MOTOR ARE IN ACCORDANCE WITH MC999-0096. THIS MOTOR IS SAME AS USED ON STANDARD (HEAVYWEIGHT) PAYLOAD RETENTION LATCH WHICH HAS BEEN QUALIFIED FOR ORBITER ENVIRONMENT AND OPERATION IN ORBITAL MISSIONS.

**(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).

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

**(C) INSPECTION:****RECEIVING INSPECTION**

MATERIAL AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION. INSPECTION VERIFIES THAT A SAMPLE FROM EACH LOT OF MATERIAL IS SPECTROSCOPICALLY ANALYZED TO VERIFY MATERIAL CHEMISTRY.

**CONTAMINATION CONTROL**

ALL PARTS ARE CLEANED BEFORE ENTERING STOCK ROOM AND RECLEANED BEFORE ENTERING CLEAN ROOM VERIFIED BY INSPECTION. INSPECTION VERIFIES THAT PARTS ARE CLEANED TO LEVEL "VISIBLY CLEAN" OF MAO110-311 PRIOR TO

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ASSEMBLY. MOTOR/BRAKE ASSEMBLY IS ASSEMBLED IN A CLASS 10,000 CLEAN ROOM, VERIFIED BY INSPECTION.

**ASSEMBLY/INSTALLATION**

ALL PARTS ARE DIMENSIONALLY INSPECTED VERIFIED BY INSPECTION. ASSEMBLY OPERATIONS ARE VERIFIED BY INSPECTION. RTV APPLICATION TO KEEP MOISTURE OUT OF THE MOTOR IS VERIFIED BY INSPECTION.

**CRITICAL PROCESSES**

HEAT TREATING AND SOLDERING IS VERIFIED BY INSPECTION. PASSIVATION OF STAINLESS STEEL PARTS IS VERIFIED BY INSPECTION. EXAMINATION OF SOLDER JOINTS BEFORE THEY ARE CLOSED UP AND SEALED IN WINDINGS IS A MANDATORY INSPECTION POINT. HEAT TREATING OF SHAFTS IS VERIFIED BY HARDNESS TEST.

**TESTING**

ATP (INCLUDING TESTING AT EXTREME TEMPERATURES, AT VARIOUS LOADS, AND AT VARIOUS POSITIONS) IS VERIFIED PER PROCEDURE. WINDING RESISTANCE TEST IS VERIFIED BY INSPECTION. HIGH POTENTIAL TEST IS VERIFIED BY INSPECTION.

**HANDLING/PACKAGING**

HANDLING AND PACKAGING REQUIREMENTS ARE 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  
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TECHNICAL APPROVAL : VIA CR

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