

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE  
NUMBER:M7-102-ML1 -X**

**SUBSYSTEM NAME: CREW EQUIPMENT**

**REVISION: 0 07/26/99**

**PART DATA**

	<b>PART NAME VENDOR NAME</b>	<b>PART NUMBER VENDOR NUMBER</b>
LRU	:LIGHT WEIGHT MIDDECK STOWAGE LOCKER ASSY	V602-660800-001
SRU	:DOOR LATCH ASSY	V697-10950

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
LIGHT WEIGHT MIDDECK STOWAGE LOCKER ASSEMBLY (LWMSLA) DOOR LATCH.

**QUANTITY OF LIKE ITEMS: 88**  
88 LATCHES PER VEHICLE  
2 LATCHES PER LOCKER DOOR

**FUNCTION:**  
THERE ARE 44 LIGHT WEIGHT MIDDECK STOWAGE LOCKER ASSEMBLIES (LWMSLA).  
EACH LWMSLA CONTAINS A SINGLE DOOR. EACH DOOR HAS TWO LATCHES THAT  
KEEP IT IN A CLOSED AND LOCKED POSITION.

**REFERENCE DOCUMENTS:**

- SDD39119020
- SDD39119021
- SDD39119022
- SDD39119023
- SDD39119025
- SDD39119027
- SDD39119028
- SDD39119029
- V697-10960
- V697-10970
- MS51957-12
- SSBH-54N
- U164-0050-S
- WSM-75
- MS 19060-4812

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: M7-102-ML1-02

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SUBSYSTEM NAME: CREW EQUIPMENT

LRU: LIGHT WEIGHT MIDDECK STOWAGE LOCKER ASSY

ITEM NAME: DOOR LATCH ASSY

CRITICALITY OF THIS  
FAILURE MODE: 2/2

FAILURE MODE:  
BINDING/JAMMED

MISSION PHASE: OO ON-ORBIT

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

CAUSE:

CONTAMINATION, STRUCTURAL FAILURE DUE TO MECHANICAL SHOCK,  
MANUFACTURER/MATERIAL DEFECT, LACK OF LUBRICATION

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)

METHOD OF FAULT DETECTION:

PHYSICAL OBSERVATION

REMARKS/RECOMMENDATIONS:

IF THE LOCKER DOOR CANNOT BE OPENED, CREW MEMBERS *could use* CAN USE AVAILABLE TOOLS TO REMOVE THE DOOR LATCHES.

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**(A) SUBSYSTEM:**

INABILITY TO OPEN LWMSLA DOOR.

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

INABILITY TO OPEN A DOOR WOULD PREVENT USE OF THE TOOLS OR OTHER ITEMS CONTAINED IN THE LWMSLA.

**(C) MISSION:**

LOSS OF MISSION IF UNABLE TO UTILIZE TOOLS OR OTHER ITEMS CONTAINED IN THE LWMSLA.

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

NO EFFECT

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

POTENTIAL LOSS OF MISSION IF UNABLE TO UTILIZE TOOLS OR OTHER ITEMS CONTAINED IN THE LWMSLA.

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- TIME FRAME -

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**TIME FROM FAILURE TO CRITICAL EFFECT: DAYS**

**TIME FROM FAILURE OCCURRENCE TO DETECTION: IMMEDIATE**

**TIME FROM DETECTION TO COMPLETED CORRECTING ACTION: MINUTES**

**IS TIME REQUIRED TO IMPLEMENT CORRECTING ACTION LESS THAN TIME TO EFFECT?  
YES**

**RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:  
IF THE LOCKER DOOR CANNOT BE OPENED, CREW MEMBERS CAN USE OTHER  
AVAILABLE TOOLS TO REMOVE THE DOOR LATCHES.**

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-DISPOSITION RATIONALE-

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**(A) DESIGN:**

THE LWMSLA IS A SANDWICH STRUCTURE CONSISTING OF GRAPHITE COMPOSITE SKINS WITH ALUMINUM HONEYCOMB CORE. THE LOCKER DOOR IS ATTACHED TO THE CONTAINER WITH CLOSE TOLERANCE PIANO TYPE HINGES ON ONE SIDE AND TWO ROTARY LATCHES ON THE OPPOSITE SIDE. THE DOOR HAS ROTATIONAL FREEDOM OF 180° AND MOVEMENT IN THE Y- AXIS OF 0.008 INCH IN EITHER DIRECTION. THE DOOR LATCH HAS TWO MAIN COMPONENTS, A ROTARY LATCH HOUSING, AND A LATCH STUD. THE ROTARY LATCH HOUSING IS MOUNTED TO THE LOCKER DOOR WITH TWO FASTENERS AND A DOOR LATCH FITTING THAT IS FABRICATED FROM 7050 ALUMINUM. THE LATCH HOUSING HAS A RETAINER RING, SLEEVE, KNOB, BASE, SCREW AND BALL

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ROTARY LATCHES ON THE OPPOSITE SIDE. THE DOOR HAS ROTATIONAL FREEDOM OF 180° AND MOVEMENT IN THE Y- AXIS OF 0.008 INCH IN EITHER DIRECTION. THE DOOR LATCH HAS TWO MAIN COMPONENTS, A ROTARY LATCH HOUSING, AND A LATCH STUD. THE ROTARY LATCH HOUSING IS MOUNTED TO THE LOCKER DOOR WITH TWO FASTENERS AND A DOOR LATCH FITTING THAT IS FABRICATED FROM 7050 ALUMINUM. THE LATCH HOUSING HAS A RETAINER RING, SLEEVE, KNOB, BASE, SCREW AND BALL BEARING. THE KNOB, BASE, AND STUD ARE MADE OF CRES 15-5 PH STEEL. THE SLEEVE AND RETAINER RING ARE MADE OF CRES 304 AND CRES 302 STEEL. THE BALL BEARING AND SCREW ARE MADE OF STEEL. THE STUD PORTION IS ATTACHED TO THE LATCH FITTING ON THE LOCKER CONTAINER WITH SPACER SPRING AND RETAINER NUT THAT IS FABRICATED FROM CRES 304 STEEL AND 7075 ALUMINUM. WITH THE DOOR CLOSED, ROTATING THE HOUSING TO A LATCHED POSITION LOCKS 4 CAPTURED BALL BEARINGS IN THE HOUSING. THESE BALL BEARINGS ENGAGE THE LATCH STUD. THE LATCH HOUSING HAS A HANDLE THAT CAN BE POSITIONED FLUSH WITH THE DOOR AND IS HELD IN THE FLUSH POSITION WITH FRICTION FROM A WAVE WASHER. THE HANDLE IS MADE OF CRES 15-5 PH STEEL, AND THE WASHER IS MADE OF STEEL.

A STRUCTURAL LOAD ANALYSIS WAS PERFORMED ON ALL COMPONENTS OF THE LWMSLA. ALL COMPONENTS WERE SHOWN TO HAVE OF FACTOR OF SAFETY OF 1.4 MINIMUM. THE LWMSLA IS NOT DEGRADED BY PRESSURE DIFFERENTIALS AND IS CAPABLE OF WITHSTANDING A PRESSURE RANGE OF 3.2 PSIA TO 30.0 PSIA. ALL MATERIALS HAVE BEEN SELECTED FOR MINIMUM OFFGASSING AND ARE APPROVED IN MATCO REPORTS FOR USE IN THE CREW COMPARTMENT ENVIRONMENT. THE GROUND, FERRY FLIGHT AND ON- ORBIT TEMPERATURE DIFFERENTIAL PERFORMANCE REQUIREMENTS FOR THE LWMSLA ARE CERTIFIED THROUGH THERMAL ANALYSIS. THE FUNGUS, HUMIDITY, LIGHTNING, OZONE, SALINITY, SHOCK, ACCELERATION, AEROACOUSTIC NOISE AND CABIN ATMOSPHERE REQUIREMENTS ARE ALL VERIFIED BY ANALYSIS AND/OR ASSESSMENT.

THE OPERATING LIFE AND USEFUL LIFE REQUIREMENTS, BASED ON A REVIEW OF THE DESIGN, WERE SHOWN TO HAVE A MINIMUM OPERATIONAL LIFE OF 100 ORBITAL MISSIONS AND A USEFUL LIFE OF 10 YEARS.

**(B) TEST:**

1) STATIC QUALIFICATION TEST. STATIC QUALIFICATION TESTS ARE PERFORMED ON THE LWMSLA. THERE ARE TWO SEPARATE TEST CONFIGURATIONS REQUIRED TO ADEQUATELY TEST OPERATIONAL LOAD CONDITIONS FOR THE INERTIAL LOAD TEST AND THE INTERFACE SHEAR PLANE TEST. THE INERTIAL LOAD TEST IS PERFORMED IN 3 PHASES INCLUDING INFLUENCE COEFFICIENTS, OPERATIONAL LOADS, AND EMERGENCY LANDING LOADS. INFLUENCE COEFFICIENT TESTING INCLUDES 6 UNIT LOAD CASES USED FOR STIFFNESS MODEL VALIDATION OF BOTH NOMINAL AND FAIL-SAFE SUPPORT CONDITIONS. QUALIFICATION TESTING INCLUDES 11 LOAD CASES REPRESENTING THE WORST CASE LIFT-OFF, LANDING, AND EMERGENCY LANDING CONDITIONS.

2) RANDOM VIBRATION QUALIFICATION TEST. RANDOM VIBRATION QUALIFICATION TESTS ARE PERFORMED ON THE LWMSLA TEST ARTICLE. THE TEST ARTICLE IS MOUNTED ON A VIBRATION TEST MACHINE USING A RIGID ADAPTER PLATE TO WHICH THE LOCKER WAS MOUNTED VIA ITS 4 MILSON FASTENERS. THE INTERNAL MASS

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SIMULATOR INCLUDED A FLIGHT STOWAGE TRAY WITH A CONCENTRATED MASS EQUAL TO 60 LBS POSITIONED IN SUCH A WAY THAT THE CENTER OF GRAVITY IS SET 14 INCHES FROM THE LOCKER MOUNTING. THE VIBRATION ENVIRONMENT WAS PERFORMED IN EACH OF THE 3 ORTHOGONAL AXES FOR A DURATION OF 48 MINUTES PER AXIS.

3) ACCEPTANCE TESTING. THE LWMSLA TEST ARTICLE IS SUBJECTED TO THE FOLLOWING ACCEPTANCE TESTS: VISUAL EXAMINATION AND LOAD TEST (LOCKER SHELL ASSEMBLY ONLY). BOTH OF THESE ACCEPTANCE TEST/INSPECTIONS ARE PERFORMED ON EACH FLIGHT UNIT. THEY CONSIST OF:

- VISUAL EXAMINATION: THE LWMSLA IS VISUALLY EXAMINED AND VERIFIED TO CONFORM TO THE FOLLOWING: (1) WORKMANSHIP-COMPOSITE SURFACES, LATCHES, HINGE, AND FITTINGS. (2) CLEANLINESS- VISUALLY CLEAN. (3) IDENTIFICATION-ACCURACY OF INFORMATION AS COMPARED TO THE ASSEMBLY DRAWING AND (4) TRACEABILITY- ORDER CONTROL NUMBER (OCN).
- LOAD TEST: LOAD TEST OF 520 +/- 5 LBS IN +/- Z AXIS DIRECTIONS TO VERIFY DOOR LATCH AND CORNER FITTING BOND INTEGRITY.

4) FUNCTIONAL TEST. DOOR AND LATCH TESTS ARE PERFORMED PER V602-660800 DRAWING AS PART OF THE DOOR RIGGING. THIS INCLUDES THE FOLLOWING VERIFICATIONS: DOOR LATCH ENGAGED AND DISENGAGED FORCES; DOOR LATCH OPEN AND CLOSED; TORQUE TOOL FASTENER ENGAGED WITH AN ENGAGED DOOR AND LATCH ASSEMBLY.

**(C) INSPECTION:**

**RECEIVING INSPECTION**

RECEIVING INSPECTION VERIFIES MATERIAL AND PROCESS CERTIFICATIONS.

**CONTAMINATION CONTROL**

CONTAMINATION AND CORROSION PROTECTION REQUIREMENTS ARE VERIFIED BY INSPECTION. CLEANLINESS LEVEL GENERALLY CLEAN (GC) PER MA0110-301.

**ASSEMBLY/INSTALLATION**

DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. ALL PARTS ARE FABRICATED AND INSPECTED AT THE DETAIL LEVEL AND THE ASSEMBLY LEVEL. BONDING OF THE ASSEMBLY IS VERIFIED BY INSPECTION.

**NON DESTRUCTIVE EVALUATION**

PRIOR TO PAINTING, LATCHES ARE INSPECTED AT A DETAIL LEVEL USING NON-DESTRUCTIVE METHODS.

**TESTING**

INSPECTION VERIFIES THAT THE DOOR LATCH MECHANISM WILL OPERATE FREELY.

**HANDLING/PACKAGING**

HANDLING, PACKAGING, STORAGE, AND SHIPPING PROCEDURES ARE 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 DATABASE.

(E) OPERATIONAL USE:

IF THE LOCKER DOOR CANNOT BE OPENED, CREW MEMBERS CAN USE OTHER AVAILABLE TOOLS TO REMOVE THE DOOR LATCHES.

*could be*

- APPROVALS -

S&RE ENGINEER	: V. T. NGUYEN
S&RE MANAGER	: D. F. MIKULA
DESIGN ENGINEER	: M. HOULE
SUBSYSTEM MANAGER	: S. L. SHARP
SR&QA	:
NASA DCE	:
NASA MOD	: V. P. Badillo
USA SAM	: W. H. Woodworth
USA ORBITER	:

*for*

*for*

*M. Houle*

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