

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- GIL HARDWARE
NUMBER:M7-102-ML2 -X**

SUBSYSTEM NAME: CREW EQUIPMENT

REVISION: 0 07/26/99

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:LIGHT WEIGHT MIDDECK STOWAGE LOCKER ASSY	V602-660800-001
SRU	:DOOR HINGE ASSY	V697-10980-001

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

QUANTITY OF LIKE ITEMS: 88
88 HINGES PER VEHICLE
2 HINGES PER LOCKER

FUNCTION:
THERE ARE 44 LIGHT WEIGHT MIDDECK STOWAGE LOCKER ASSEMBLIES (LWMSLA).
EACH LWMSLA CONTAINS A SINGLE DOOR. EACH DOOR HAS TWO HINGES THAT KEEP
THE DOOR ATTACHED TO THE LOCKER.

REFERENCE DOCUMENTS: V897-10950
 V697-10981
 V697-10970

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: M7-102-ML2-01

REVISION#: 0 07/26/99

SUBSYSTEM NAME: CREW EQUIPMENT

LRU: LIGHT WEIGHT MIDDECK STOWAGE LOCKER ASSY

ITEM NAME: DOOR HINGE ASSY

CRITICALITY OF THIS

FAILURE MODE: 1R3

FAILURE MODE:

BREAKS UNDER FLIGHT LOAD

MISSION PHASE:

LO LIFT-OFF
 DO DE-ORBIT
 LS LANDING/SAFING

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

CAUSE:

VIBRATION, MECHANICAL SHOCK, MATERIAL DEFECT

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS
 B) FAIL
 C) PASS

PASS/FAIL RATIONALE:

A)

B)

FAILS SCREEN "B" DURING LIFT-OFF/DE-ORBIT SINCE THE CREW CANNOT DETECT THE FAILURE AND/OR PERFORM CORRECTIVE ACTION.

C)

PASSES SCREEN "C" SINCE THERE IS NO SINGLE CREDIBLE FAILURE THAT COULD RESULT IN LOSS OF BOTH HINGES FOR NOMINAL MISSION.

METHOD OF FAULT DETECTION:

NONE FOR LIFT-OFF/DE-ORBIT PHASES. VISUAL OBSERVATION OF THE LWMSLA DURING ON-ORBIT COULD DETECT A HINGE FAILURE.

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REMARKS/RECOMMENDATIONS:

IF THE LOCKER DOOR CANNOT BE CLOSED, CREW MEMBERS COULD REPLACE THE HINGE PIN OR MOVE THE CONTENTS TO ANOTHER LOCKER.

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF ONE DOOR HINGE. NO EFFECT SINCE REDUNDANT HINGE AND LATCHES WILL KEEP THE DOOR IN PLACE.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT FIRST FAILURE.

(C) MISSION:

NO EFFECT FIRST FAILURE.

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

NO EFFECT FIRST FAILURE. SEVERE DAMAGE TO THE ORBITER AND/OR CREW INJURY OR LOSS OF LIFE COULD RESULT AFTER THREE FAILURE (TWO HINGES AND ONE LATCH FAIL) DUE TO INABILITY TO SECURE TOOLS OR OTHER ITEMS IN THE LOCKER.

(E) FUNCTIONAL CRITICALITY EFFECTS:

SEVERE DAMAGE TO THE ORBITER AND/OR CREW INJURY OR LOSS OF LIFE COULD RESULT AFTER THREE FAILURES (FIRST HINGE FAILS, REDUNDANT HINGE FAILS, AND LATCH FAILS) DUE TO INABILITY TO SECURE TOOLS OR OTHER ITEMS IN THE LOCKER.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: MINUTES

TIME FROM FAILURE OCCURRENCE TO DETECTION: N/A

TIME FROM DETECTION TO COMPLETED CORRECTING ACTION: N/A

**IS TIME REQUIRED TO IMPLEMENT CORRECTING ACTION LESS THAN TIME TO EFFECT?
NO**

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:

THERE IS NO CORRECTIVE ACTION IF THE DOOR AND TOOLS BECOME DISLODGED AND ARE ALLOWED TO MOVE FREELY WITHIN THE CREW COMPARTMENT DURING LIFT-OFF, DE-ORBIT, OR LANDING

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HAZARD REPORT NUMBER(S): ORBI 257

**HAZARD(S) DESCRIPTION:
CREW INJURY, POSSIBLE LOSS OF CREW, VEHICLE DAMAGE**

-DISPOSITION RATIONALE-

(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 LOCKER HAS TWO HINGES AND MAINTAINED IN THE OPENED POSITION BY TWO HINGE PINS. THE DOOR HAS ROTATIONAL FREEDOM OF 180° AND MOVEMENT IN THE Y-AXIS OF 0.008 INCH IN EITHER DIRECTION. THE HINGE IS MADE FROM ALUMINUM ALLOY 2024. HINGE ASSEMBLY IS BOLTED AND BONDED TO THE LWMSLA WITH 8 FASTENERS.

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 LIFTOFF, 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 620 +/- 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.

(G) 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:

THERE IS NO CORRECTIVE ACTION DURING LIFT-OFF/DE-ORBIT/LANDING PHASES.

DURING ON-ORBIT, CREW MEMBERS COULD REPLACE THE HINGE PIN OR MOVE THE CONTENTS TO ANOTHER LOCKER.

- APPROVALS -

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