

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: 02-5E-L05-XSUBSYSTEM NAME: PAYLOAD RETEN & DEPLOY - IUS DAMPER/LATCHES
REVISION : 3 10/08/90

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: LIGHTWEIGHT LONGERON LATCH	V073-544100
LRU	: MIDDLEWEIGHT LONGERON LATCH	V073-544230
LRU	: SUPER MIDDLE WT LONGERON LATCH	V073-544530
■ SRU	: LATCH/TRUNNION & BRIDGE INTRFC	V073-544101(LWLL)
■ SRU	: LATCH/TRUNNION & BRIDGE INTRFC	V073-544229(MWLL)
■ SRU	: LATCH/TRUNNION & BRIDGE INTRFC	V073-544529(SMWLL)

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

QUANTITY OF LIKE ITEMS:
20 MAX

FUNCTION:

THE LIGHTWEIGHT, MIDDLEWEIGHT OR SUPER MIDDLEWEIGHT LONGERON LATCH CAN BE MOUNTED IN A PRIMARY (FIXED) CONFIGURATION OR A SECONDARY CONFIGURATION WHERE IT IS FREE TO SLIDE (WITHIN LIMITS) ALONG THE BRIDGE TO ALLOW DYNAMIC REACTION OF PAYLOAD/ORBITER STRUCTURE DURING LAUNCH AND ENTRY. DESIGN ALSO INCLUDES SPHERICAL BEARINGS WITHIN THE LATCH TO ALLOW LIMITED ROTATION AND SLIDING OF THE PAYLOAD TRUNNION IN THE LATCH TO FURTHER RELIEVE LAUNCH AND ENTRY LOADS.

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NUMBER: 02-5E-105-01

REVISION# 3 10/08/90 R
SUBSYSTEM: PAYLOAD RETEN & DEPLOY - IUS DAMPER/LATCHES
LRU :LIGHTWEIGHT LONGERON LATCH
ITEM NAME: LATCH/TRUNNION & BRIDGE INTRFC
CRITICALITY OF THIS FAILURE MODE:1/1

FAILURE MODE:
PHYSICAL BINDING/JAMMING

MISSION PHASE:

LO LIFT-OFF
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, LOSS OF LUBRICANT

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)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
FAILURE RESULTS IN LOSS OF ABILITY FOR PAYLOAD/ORBITER TO FLEX AND RELIEVE LAUNCH AND ENTRY LOADS.

(B) INTERFACING SUBSYSTEM(S):
PAYLOAD/ORBITER TO BE SUBJECTED TO EXCESSIVE LOADS DURING ASCENT AND ENTRY.

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(C) MISSION:

FAILURE OF LATCH TO SLIDE ON BRIDGE MAY PRECLUDE BERTHING OF PAYLOAD OR CLOSING OF LATCH AND RESULT IN LOSS OF MISSION.

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

FAILURE MAY CAUSE LOSS OF CREW AND VEHICLE DUE TO EXCESSIVE LOADS DURING ASCENT OR ENTRY.

(E) FUNCTIONAL CRITICALITY EFFECTS:

- DISPOSITION RATIONALE -

(A) DESIGN:

THE PAYLOAD SUPPORT POINTS ARE SELECTED TO MINIMIZE POINT TORSIONAL, BENDING AND RADIAL LOAD IMPARTED TO THE PAYLOADS. TRUNNION FRICTION LOADS ARE MINIMIZED TO $C_f = 0.10$ TO 0.25 , BRIDGE FRICTION $C_f = 0.10$ TO 0.12 DEPENDING UPON ENVIRONMENT AND LOAD. MATERIAL, FINISHES AND LUBRICANT ARE SELECTED TO PROVIDE MINIMUM COEFFICIENT OF FRICTION. TRUNNION INTERFACE USES SPHERICAL BEARING AND FIBRILOID LINER. BRIDGE INTERFACE USES DRY LUBE FINISH.

(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 $0.04 \text{ g}^2/\text{HZ}$ FROM 80 TO 350 HZ, ALL AXES. THERMAL - STABILIZED RANGE FROM -180 DEG F TO $+255 \text{ DEG F}$. FUNCTIONAL TESTS CONDUCTED AT -80 DEG F , $+70 \text{ DEG F}$, AND $+255 \text{ DEG F}$. 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), METEORIODS, 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),

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TRUNNION/BRIDGE FRICTION, MECHANICAL STOPS, AND EXPLOSIVE ATMOSPHERE.

QMRSD: GROUND TURNAROUND INCLUDES PAYLOAD RETENTION LATCH BEARING AND DRY LUBE INSPECTION.

(C) INSPECTION:

RECEIVING INSPECTION

MATERIAL AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS REQUIREMENTS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MACHINING AND DIMENSIONS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PENETRANT INSPECTION VERIFIED BY INSPECTION.

CRITICAL PROCESSES

CHROME PLATING AND ADHESIVE BONDING OF FIBRILOID LINER TO TRUNNION INTERFACE VERIFIED BY INSPECTION. APPLICATION OF LB0140-005 DRY FILM LUBE TO BRIDGE INTERFACE VERIFIED BY INSPECTION. HEAT TREATING VERIFIED BY INSPECTION.

TESTING

ATP VERIFIED PER PROCEDURE.

HANDLING/PACKAGING

PARTS PACKAGED AND PROTECTED PER APPLICABLE PACKAGING SPECIFICATIONS VERIFIED BY INSPECTION.

■ (D) FAILURE HISTORY:

CAR NO. A00458 : BY SIMILARITY TO THE LIGHTWEIGHT KEEL LATCH DURING QUALIFICATION TESTING, THE DRY FILM LUBE SHOWED SIGNS OF WEAR IN THE RAIL AREA; DRY FILM LUBE SUPPLIER DID NOT ALLOW FOR THE ASSEMBLY TO ATTAIN REQUIRED TEMPERATURE AND AS A RESULT, THE DRY FILM LUBE DID NOT CURE; MCR 11772 AUTHORIZED MEK WIPE TEST ON ALL LATCHES AND BRIDGES SUSPECTED OF NOT BEING CURED. DRY FILM LUBE SUPPLIER PROCEDURES WERE REVISED TO INCLUDE VERIFICATION OF CURE BY WIPE TEST.

(E) OPERATIONAL USE:

NONE.

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- APPROVALS -

RELIABILITY ENGINEERING: D. M. MAYNE
DESIGN ENGINEERING : D. S. CHEUNG
QUALITY ENGINEERING : D. J. BUTTNER
NASA RELIABILITY :
NASA SUBSYSTEM MANAGER :
NASA QUALITY ASSURANCE :

D.M. Mayne
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G.E. : *[Signature]* 2/7/91
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