FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: 02-5E-L01-X

SUBSYSTEM NAME: PAYLOAD RETEN & DEPLOY - IUS DAMPER/LATCHES
REVISION : 2 03/29/90

		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 DRIVE MECHANISM	V073-544210

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

■ QUANTITY OF LIKE ITEMS:
20 MAX

■ FUNCTION:
LIGHTWEIGHT, MIDDLEWEIGHT OR SUPER MIDDLEWEIGHT LONGERON LATCHES REACT FLIGHT LOADS ON PAYLOAD HORIZONTAL TRUNNION HELD BETWEEN TWO SPHERICAL HALF BEARINGS. REDUNDANT MOTORS DRIVE A DIFFERENTIAL AND GEARBOX TO ACTUATE THE DRIVE LINKAGES AND HOOK. THERE IS NO TORQUE LIMITER IN THE LATCH.

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SUBSYSTEM: PAYLOAD RETEN & DEPLOY - IUS DAMPER/LATCHES

ITEM NAME: LATCH DRIVE MECHANISM

CRITICALITY OF THIS FAILURE MODE: 1/1

■ FAILURE MODE:
PHYSICAL BINDING/JAMMING

MISSION PHASE:
OO ON-ORBIT
OO DE-ORBIT

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

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

■ 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:
LOSS OF ABILITY TO DRIVE THE LATCH OPEN OR CLOSED.

■ (B) INTERFACING SUBSYSTEM(S):
INABILITY TO EITHER UNBERTH PAYLOAD (IF FAILED CLOSED OR PARTIALLY CLOSED) OR RESTRAIN PAYLOAD (IF FAILED OPEN OR PARTIALLY OPEN). PRO-

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CEDURALLY, DRIVE COMMAND WILL BE REMOVED BEFORE MOTOR BURNOUT CAN OCCUR.

- (C) MISSION:
POSSIBLE LOSS OF MISSION DUE TO INABILITY TO UNBERTH OR RESTRAIN PAYLOAD.

- (D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE DUE TO UNRESTRAINED PAYLOAD DURING ENTRY.

- (E) FUNCTIONAL CRITICALITY EFFECTS:

- DISPOSITION RATIONALE -

- (A) DESIGN:
PARTS OF DRIVE MECHANISM ARE MADE OF HIGH STRENGTH, HEAT AND CORROSION RESISTANT NICKEL ALLOY (INCONEL 718); ALSO MP35N ALLOY FOR SUPER MIDDLEWEIGHT LATCH. FACTOR OF SAFETY IS 1.4 OVER LIMIT LOADS, POSITIVE MARGINS ON ALL COMPONENTS. DUAL ROTATION SURFACES HAVE BEEN EMPLOYED ON DRIVE MECHANISM. DUAL MOTORS AND SWITCHES ARE USED FOR REDUNDANCY. MANUAL DRIVE USING A STANDARD 7/16 INCH SOCKET WRENCH IS PROVIDED FOR EMERGENCY EXTRAVEHICULAR ACTIVITY (EVA). BASIC DESIGN IS SAME AS PAYLOAD RETENTION LATCH ACTUATOR (PRLA).

- (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 g2/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, +70 DEG F, 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. 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), METEOROIDS, 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,

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THERMAL CYCLING, FULL OPERATING LIFE, QUALIFICATION ACCEPTANCE VIBRATION TEST (QAVT), QUALIFICATION ACCEPTANCE THERMAL TEST (QATT), TRUNNION/BRIDGE FRICTION, MECHANICAL STOPS, AND EXPLOSIVE ATMOSPHERE.

OMRSD: GROUND TURNAROUND INCLUDES RELEASE OPERATION (SYSTEM 1), LATCHING OPERATION (SYSTEM 1), RELEASE OPERATION (SYSTEM 2), AND LATCHING OPERATION (SYSTEM 2).

■ (C) INSPECTION:
RECEIVING INSPECTION
MATERIAL AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
INSPECTION VERIFIES CLEANLINESS IS MAINTAINED. INSPECTION VERIFIES CORROSION PROTECTION PER MA0608-3C1.

ASSEMBLY/INSTALLATION
DIMENSIONS OF DETAIL PARTS VERIFIED BY INSPECTION. FASTENER INSTALLATION IS VERIFIED BY INSPECTION. ASSEMBLY AND RIGGING OF LATCH IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
PENETRANT INSPECTION OF DETAIL PARTS IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
APPLICATION OF LB0140-005 DRY FILM LUBRICANT PER MA0112-302 IS VERIFIED BY INSPECTION. HEAT TREATING IS VERIFIED BY INSPECTION.

TESTING
ACCEPTANCE TESTING OF THE LATCH ASSEMBLY PRIOR TO DELIVERY IS VERIFIED PER PROCEDURE.

HANDLING/PACKAGING
HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

■ (D) FAILURE HISTORY:
THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH THIS FAILURE MODE.

■ (E) OPERATIONAL USE:
CREW COULD ATTEMPT TO RELIEVE JAMMED CONDITION BY REVERSING AND RECYCLING LATCH OR EVA CREWMAN COULD ATTEMPT TO OPEN/CLOSE LATCH MANUALLY USING EMERGENCY DRIVE SOCKET. HOWEVER, EVA PROCEDURES WILL NOT BYPASS THIS FAILURE IN THE LINKAGES AND HOOK.

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- APPROVALS -

RELIABILITY ENGINEERING	D. M. MAYNE	D.M. Mayne
DESIGN ENGINEERING	D. S. CHEUNG	D. S. Cheung
QUALITY ENGINEERING	O. J. BUTTNER	O.J. Buttner 4/2/90
NASA RELIABILITY	C.E	5/3/90
NASA SUBSYSTEM MANAGER		5/3/90
NASA QUALITY ASSURANCE		4/16/90