

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : P/L RETEN & DEPLOY-LATCHES FMEA NO 02-5E -K01 -4 REV:04/04/88

ASSEMBLY : LIGHTWEIGHT KEEL LATCH	CRIT. FUNC:	1
P/N RI : V073-544300	CRIT. HDW:	1
P/N VENDOR:	VEHICLE	102 103 104
QUANTITY : 5 MAX	EFFECTIVITY:	X X X
	PHASE(S):	PL LO X OO X DO X LS

PREPARED BY:	REDUNDANCY SCREEN:	A-	B-	C-
DES D. S. CHEUNG	APPROVED BY: <i>as. Sampson</i>	APPROVED BY (NASA):		
REL M. B. MOSKOWITZ	DES <i>Mc</i> <i>R. G. CAMPBELL</i>	SSM <i>[Signature]</i>		
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ITEM:
DRIVE MECHANISM

FUNCTION:
LIGHTWEIGHT KEEL LATCH REACTS FLIGHT LOADS ON PAYLOAD VERTICAL TRUNNION HELD BETWEEN TWO SPHERICAL HALF BEARINGS. MOTORS ACT THROUGH A DIFFERENTIAL AND GEARBOX TO ACTUATE THE MECHANISM LINKAGES, BALLSCREW AND SECONDARY FRAME. THERE IS NO TORQUE LIMITER IN THE LATCH.

FAILURE MODE:
FAILS FREE

CAUSE(S):
CORROSION, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, EXCESSIVE LOAD, FAILURE/DEFLECTION OF INTERNAL PART, FATIGUE

EFFECTS ON:
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE

(A) LOSS OF ABILITY TO MAINTAIN OR ACHIEVE AN OVERCENTER CONDITION.
(B) INABILITY TO RESTRAIN THE KEEL TRUNNION OF A BERTHED PAYLOAD.
(C) POSSIBLE LOSS OF MISSION DUE TO INABILITY TO RESTRAIN PAYLOAD.
(D) POSSIBLE LOSS OF CREW/VEHICLE DUE TO UNRESTRAINED PAYLOAD DURING ASCENT/ENTRY.

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DISPOSITION & RATIONALE:

(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE

(A) DESIGN

LINKAGE HAS DUAL ROTATING SURFACES AT PIVOTS, LATCH WAS QUALIFIED TO ORBITER ENVIRONMENTS, BALL SCREW ASSEMBLY IS IDENTICAL TO ASSEMBLY USED IN PREVIOUSLY QUALIFIED LATCH, BALL SCREW ASSEMBLY HAS THREAD SEALS, ICE SCRAPER, SHIELDS AT EACH END OF BALL NUT, FACTOR OF SAFETY OF ALL COMPONENTS IS 1.4 OVER LIMIT LOADS, POSITIVE MARGINS ON ALL COMPONENTS SHOWN BY ANALYSIS, REDUNDANT ELECTRIC MOTORS PROVIDED, GEARBOX IS SEALED TO EXCLUDE CONTAMINATION.

(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, 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: THE FOLLOWING IS A SUMMATION OF TESTS CONDUCTED PER CR 44-544300-001 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 ACCEPTED BY ANALYSIS INCLUDE FUNGUS, OZONE, SALT SPRAY, ACCELERATION, SOLAR RADIATION (THERMAL AND NUCLEAR), METEOROIDS, SAND AND DUST, STORAGE, SAFETY FACTOR, RELIABILITY, MAINTAINABILITY, MATERIALS AND PROCESSES, ELECTRICAL DESIGN AND SAFETY. CERTIFICATION BY SIMILARITY INCLUDED VACUUM, HUMIDITY, TRUNNION FRICTION AND EXPLOSIVE ATMOSPHERE.
VIBRATION - QUALIFICATION ACCEPTANCE VIBRATION TEST (QAVT) RANGE OF 20 TO 2,000 HZ WITH MAXIMUM LEVEL OF 0.067 g²/HZ AT 80 TO 350 HZ, FOR ALL AXES. FLIGHT VIBRATION LEVEL - 20 TO 2,000 HZ WITH MAXIMUM LEVEL OF 0.01 g²/HZ AT 100 TO 300 HZ, FOR ALL AXES. SHOCK BENCH HANDLING TEST IN ACCORDANCE WITH MIL-STD-810C METHOD 516.2 PROCEDURE V. THERMAL - STABILIZED RANGE FROM -100 DEG F TO +275 DEG F. FUNCTIONAL TESTS CONDUCTED AT -100 DEG F, AMBIENT, AND +275 DEG F AT 10⁻⁶ TORR, HUMIDITY. LOAD TESTS - BY ANALYSIS OR COMBINED AXIS LOADING TO 140% LIMIT LOAD. LIFE CYCLE TESTS - 1,062 CYCLES IN ADDITION TO CYCLES CONDUCTED DURING QUALIFICATION TESTING WITH VARIOUS LOAD AND MOTOR CONDITIONS. TRUNNION/BRIDGE INTERFACE FRICTION - SINGLE AND COMBINED AXIS LOADING UP TO LIMIT LOADING IN BOTH DIRECTIONS THROUGHOUT THE ENTIRE TEMPERATURE RANGE, AS SPECIFIED IN THE INTERFACE CONTROL DOCUMENT.

OMRSD: GROUND TURNAROUND INCLUDES RELEASE OPERATIONS (SYSTEMS 1 AND 2) AND LATCHING OPERATION (SYSTEMS 1 AND 2).

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(C) INSPECTION

RECEIVING INSPECTION

MATERIAL AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

INSPECTION VERIFIES CORROSION PROTECTION REQUIREMENTS PER MA0608-301.
INSPECTION VERIFIES CLEANLINESS PER MA0110-311.

ASSEMBLY/INSTALLATION

INSPECTION VERIFIES LATCH IS RIGGED PER MLC308-0179. INSPECTION VERIFIES DIMENSIONS OF DETAIL PARTS. INSPECTION VERIFIES FASTENER INSTALLATION PER MA0101-301.

NONDESTRUCTIVE EVALUATION

INSPECTION VERIFIES PENETRANT INSPECTION OF DETAIL PARTS PER MTO501-504.

CRITICAL PROCESSES

INSPECTION VERIFIES APPLICATION OF LB0140-005 DRY FILM LUBRICANT PER SPECIFICATION AND DRAWING REQUIREMENTS. INSPECTION VERIFIES HEAT TREAT OF INCONEL 718 FOR MAXIMUM CREEP RESISTANCE PER MA0111-303.

TESTING

INSPECTION VERIFIES ACCEPTANCE TEST OF THE LATCH ASSEMBLY PER MLC108-0010 PRIOR TO DELIVERY.

HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

CAR NO. AC9822 : DURING QUALIFICATION LIMIT LOAD TEST OF LIGHTWEIGHT KEEL LATCH ASSEMBLY, T-SLOT FLANGE ON ONE SIDE BROKE AT 85% OF LIMIT LOAD; LATCH FRAME FRACTURE RESULTED FROM CORNER RADIUS BETWEEN LATCH FRAME AND RETENTION FLANGE WHICH WAS IMPROPERLY UNDERCUT; REBUILT LIGHTWEIGHT KEEL LATCH WITH A NEW FRAME WITH 0.09 INCH UNDERCUT CORNER RADIUS VERSUS 0.015 INCH MAXIMUM CORNER RADIUS OF FAILED DESIGN AND REVISION OF ALLOWABLE LOADS.

(E) OPERATIONAL USE

NONE.