

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ACTUATION MECH-PBD FMEA NO 02-4B -099 -1 REV:03/08/88

ASSEMBLY	:LATCHING MECHANISM			CRIT. FUNC:	1R
P/N RI	:V070-594170 (2 REQ)			CRIT. HDW:	2
	:V070-594223 (6 REQ)	VEHICLE	102	103	104
QUANTITY	:16	EFFECTIVITY:	X	X	X
	:8 LEFT	PHASE(S):	PL	LO	OO X DO LS
	:8 RIGHT				

PREPARED BY:		REDUNDANCY SCREEN: A-PASS B-N/A C-PASS	
DES	M. A. ALLEN	APPROVED BY:	APPROVED BY (NASA):
REL	M. B. MOSKOWITZ	DES	SSM <u>L.C. Moore</u> 3/18/88
QE	W. J. SMITH	REL	<u>[Signature]</u>
		QE	<u>[Signature]</u>

ITEM:

ACTUATING LINK (FORWARD AND AFT)

FUNCTION:

DRIVE LINK BETWEEN BELLCRANKS TO TRANSFER FORCE TO HOOK ASSEMBLY ON PAYLOAD BAY DOOR BULKHEAD LATCHES.

FAILURE MODE:

STRUCTURAL FAILURE

CAUSE(S):

EXCESSIVE LOAD, MATERIAL DEFECT, STRESS CORROSION, MANUFACTURING DEFECT, FATIGUE

EFFECTS ON:

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

(A) LOSS OF ONE BULKHEAD LATCH OUT OF A GANG OF FOUR BULKHEAD LATCHES.

(B) DOOR TO AIRFRAME DEGRADED STRUCTURAL INTEGRITY.

(C) POSSIBLE LOSS OF MISSION IF DOORS CANNOT BE OPENED. ENTRY MAY PROCEED WITH ANY SINGLE LATCH DISENGAGED, REF. JSC08934.

(D) LOSS OF TWO BULKHEAD LATCHES OUT OF A GANG OF FOUR BULKHEAD LATCHES RESULTS IN POSSIBLE LOSS OF CREW/VEHICLE DUE TO AN INABILITY TO CLOSE PAYLOAD BAY DOORS.

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DISPOSITION & RATIONALE:

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

(A) DESIGN

LATCH AND MECHANISM MATERIALS (6AL-4V TITANIUM, INCONEL 718, A286 CRES) CHOSEN FOR HIGH STRENGTH/LOW WEAR CHARACTERISTICS. LINKAGE IS DESIGNED WITH POSITIVE MARGINS OF SAFETY UP TO THE FOLLOWING POSITIONS FROM ON CENTER: FORWARD BULKHEAD LATCH 1 - 26 DEGREES; LATCH 2 - 14.5 DEGREES; LATCH 3 - 9 DEGREES; LATCH 4 - 6.5 DEGREES. AFT BULKHEAD LATCH 1 - 13 DEGREES; LATCH 2 - 10 DEGREES; LATCH 3 - 7.5 DEGREES; LATCH 4 - 6 DEGREES. LATCH REACH CAPABILITY EXCEEDS PREDICTED GAPS (LATCHES 1 AND 2 HAVE 1.17 AND 0.20 INCH MARGINS - LATCHES 3 AND 4 DRIVE AFTER 1 AND 2 HAVE ALREADY BEGUN DOOR CINCHING). ALL MECHANISMS DESIGNED WITH DUAL ROTATING SURFACES AND DUAL LOCKING DEVICES ON PIVOT SHAFTS. DESIGN OF THE ACTUATION SYSTEM PERMITS PARTIAL WORKAROUND OF THIS FAILURE MODE BY EXTRAVEHICULAR ACTIVITY (EVA) CREW IF PAYLOAD DOES NOT LIMIT ACCESS.

(B) TEST

QUALIFICATION TESTS: THE QUALIFICATION ACTUATOR IS CERTIFIED PER CR-29-287-0039-0001D (REF. FMEA/CIL 02-4B-007-3). THE PBD LATCHING MECHANISM IS CERTIFIED PER CR-29-594160-001D FOR FORWARD MECHANISM AND CR-29-594260-001E FOR AFT MECHANISM. SYSTEM QUALIFICATION TESTS ON 15 FOOT PAYLOAD BAY DOOR TEST ARTICLE (087) INCLUDED: ACCEPTANCE - TO CONFIRM ALL COMPONENTS HAVE BEEN ASSEMBLED AND RIGGED PER MLO308-0022; THERMAL CYCLE TEST - CYCLED 5 TIMES BETWEEN -40 DEG F AND +282 DEG F AT DOOR AND BETWEEN -120 DEG F AND +100 DEG F AT THE FORWARD BULKHEAD; AND CYCLED 5 TIMES BETWEEN +15 DEG F AND +325 DEG F AT DOOR AND BETWEEN -180 DEG F AND +120 DEG F AT AFT BULKHEAD; THE FWD LATCHES WERE CYCLED AT -55 DEG F AND +50 DEG F AT BULKHEAD AND AT 0 DEG F AND +190 DEG F AT DOOR. THE AFT LATCHES WERE CYCLED AT -35 DEG F AND +60 DEG F AT BULKHEAD AND AT +40 DEG F AND +245 DEG F AT DOOR.

QUAL TESTS ALSO INCLUDE: HUMIDITY TEST - ON AFT LATCH MECHANISM PER MIL-STD-810B, METHOD 507, PROCEDURE IV, CYCLE ONE TIME AT EACH MOTOR CONDITION DURING THE SECOND CYCLE; ORBITAL FUNCTIONS - 3 THERMAL CONDITIONS WITH SIMULATED THERMAL DISTORTIONS OF BULKHEAD AND SILL LONGERONS; OPERATING LIFE TEST - MECHANICAL SYSTEMS CYCLED 262 TIMES AT FORWARD BULKHEAD AND 265 TIMES AT AFT BULKHEAD; ACOUSTIC TEST - PER MF0004-014C FOR 5 MINUTES. CERTIFICATION BY ANALYSIS/SIMILARITY - INCLUDED: FUNGUS, OZONE PACKAGING, THERMAL VACUUM, SALT SPRAY, SAND/DUST SHOCK-BASIC DESIGN, ULTIMATE LOADS, ACCELERATION, MARGIN OF SAFETY AND MISSION ACOUSTIC LIFE.

ACCEPTANCE TESTS: LATCH MECHANISM RIGGED PER CONTROLLED SPECIFICATION (MLO308-002). OPERATION OF LATCHES VERIFIED IN CHECKOUT AT KSC WHICH INCLUDE PAYLOAD BAY DOOR FUNCTIONAL AND FINAL CHECK.

OMRSD: GROUND TURNAROUND INCLUDES VISUAL INSPECTION OF HARDWARE TO INSURE THAT PARTS ARE NOT BROKEN OR DEFORMED AND MONITORING FUNCTIONAL TEST FOR EVIDENCE OF BINDING OR JAMMING.

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(C) INSPECTION

RECEIVING INSPECTION

RAW MATERIAL AND PROCESS CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

INSPECTION VERIFIES CLEANLINESS, AND CORROSION CONTROL PER MA0608-301 REQUIREMENTS.

ASSEMBLY/INSTALLATION

MACHINING VERIFIED BY INSPECTION. COMPLETED ASSEMBLY VERIFIED BY INSPECTION. ALIGNMENT AND TORQUE VERIFIED BY INSPECTION. PROCESSING MATERIALS IN CONTACT WITH TITANIUM PER MF0004-018 VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

LINK IS PENETRANT INSPECTED PER MT0501-504, VERIFIED BY INSPECTION.

CRITICAL PROCESSES

BEARING INSTALLATION IS VERIFIED BY INSPECTION.

TESTING

ACCEPTANCE TESTING IS VERIFIED BY INSPECTION.

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

LATCH TOOLS ARE AVAILABLE FOR EVA WORKAROUND EXCEPT IN THE CASE OF CERTAIN PAYLOADS WHICH LIMIT ACCESS. ABORT DECISION REQUIRED IF DOOR(S) CANNOT BE OPENED.