

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ACTUATION MECH-PBD FMEA NO 02-4B -101 -1 REV:03/08/88

ASSEMBLY :LATCHING MECHANISM PBD
 P/N RI :V070-594220
 P/N VENDOR:
 QUANTITY :12
 :6 FWD BULKHEAD
 :6 AFT BULKHEAD

	VEHICLE	102	103	104	
EFFECTIVITY:	X	X	X		
PHASE(S):	PL	LO	OO	X DO	LS

PREPARED BY:
 DES M. A. ALLEN
 REL M. B. MOSKOWITZ
 QE W. J. SMITH

REDUNDANCY SCREEN: A-PASS B-N/A C-PASS
 APPROVED BY:
 DES G. Campbell APPROVED BY (NASA):
 REL M.B.M. SSM A.C. Moore 3/18/88
 QE W.J. Smith REL W.J. Smith
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ITEM:
 ROD, ACTUATING FORWARD AND AFT

FUNCTION:
 PROVIDES TRANSFER FORCE FROM THE ROTATING DRIVE SHAFT TO THE HOOK ASSEMBLIES.

FAILURE MODE:
 STRUCTURAL FAILURE

CAUSE(S):
 EXCESSIVE LOAD, MATERIAL/MANUFACTURING DEFECT, STRESS CORROSION, FATIGUE

- EFFECTS ON:
- (A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE
 - (A) LOSS OF ONE, TWO OR THREE 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) POSSIBLE LOSS OF CREW/VEHICLE IF MORE THAN ONE GANG OF BULKHEAD LATCHES FAIL TO LATCH.

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DISPOSITION & RATIONALE:

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

(A) DESIGN

ACTUATING ROD MATERIALS (BORON-ALUMINUM TUBE, INTEGRAL TITANIUM END FITTINGS, INCONEL 718 ROD ENDS) CHOSEN FOR HIGH STRENGTH/LOW WEAR CHARACTERISTICS. ACTUATING RODS EXHIBIT POSITIVE ULTIMATE MARGIN OF SAFETY FOR DESIGN CASE CONDITIONS (MAXIMUM REACH CASE). 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. 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 ML0308-0022; 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: ROD ASSEMBLY IS PROOF LOADED IN TENSION AND COMPRESSION IN ACCEPTANCE TEST.

OMRSD: GROUND TURNAROUND INCLUDES VISUAL INSPECTION OF BULKHEAD LATCH LINKAGES FOR DAMAGE OR DEFORMATION AND MONITORING FUNCTIONAL TESTS.

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(C) INSPECTION

RECEIVING INSPECTION

MATERIAL AND PROCESS CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CORROSION PROTECTION VERIFIED BY INSPECTION. CLEANLINESS REQUIREMENTS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MATERIAL ISSUED FOR TUBE AND END FITTING VERIFIED BY INSPECTION. MATERIALS WHICH CONTACT TITANIUM VERIFIED BY INSPECTION. MACHINING OPERATIONS VERIFIED BY INSPECTION. INSTALLATION OF BEARINGS AND ROD ENDS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

WELD X-RAY AND PENETRANT INSPECTED IS VERIFIED BY INSPECTION. PENETRANT INSPECTION AFTER MACHINING VERIFIED BY INSPECTION.

CRITICAL PROCESSES

WELDING IS VERIFIED BY INSPECTION. VISUAL INSPECTION REQUIRED AND DOCUMENTED ON MANUFACTURING ORDER FOR VERIFICATION OF TEST WELD, PRE-FIT, AND WELD COMPLETE. STRESS RELIEF AFTER WELD VERIFIED BY INSPECTION. BORON-ALUMINUM FABRICATION PROCEDURES VERIFIED BY INSPECTION.

TESTING

PROOF LOAD TEST VERIFIED BY INSPECTION USING APPLICABLE TOOLING.

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.