

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ACTUATION MECH-PBD FMEA NO 02-4B -140 -2 REV:03/03/88

ASSEMBLY : BULKHEAD LATCH INSTALLATION CRIT. FUNC: 1R
 P/N RI : V070-594222 CRIT. HDW: 2
 P/N VENDOR: VEHICLE 102 103 104
 QUANTITY : 4 EFFECTIVITY: X X X
 : TWO ON FORWARD BULKHEAD PHASE(S): PL LO OO X DO LS
 : TWO ON APT BULKHEAD

REUNDANCY SCREEN: A-PASS B-PASS C-PASS
 PREPARED BY: APPROVED BY: APPROVED BY (NASA):
 DES M. A. ALLEN DES *D. Campbell* SSM *R.C. Martin 3/18/88*
 REL M. B. MOSKOWITZ REL *M.B. Moskowitz* REL *W. J. Smith*
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ITEM:
 SWITCH MODULE, READY-TO-LATCH SWITCHES, BULKHEAD LATCHES

FUNCTION:
 THREE READY-TO-LATCH SWITCHES PER MODULE PROVIDE SIGNALS TO INITIATE FORWARD AND APT BULKHEAD LATCH ACTUATORS IN CLOSED (LATCHED) DIRECTION. ONE DOOR CLOSED SWITCH PER MODULE PROVIDES SIGNAL TO CUT OFF POWER TO PAYLOAD BAY DOOR DRIVE ACTUATOR IN CLOSED DIRECTION. SWITCH MODULE ARM IS ACTUATED BY CONTACT WITH DOOR STRUCTURE.

FAILURE MODE:
 CONDUCTS INADVERTENTLY, PREMATURELY CLOSES, SHORTS

CAUSE(S):
 PIECE PART STRUCTURAL FAILURE, CONTAMINATION, MECHANICAL SHOCK, VIBRATION

EFFECTS ON:
 (A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE
 (A, B) A SET OF FOUR LATCHES ON ONE END OF ONE PAYLOAD BAY DOOR MAY CLOSE PREMATURELY DURING AUTOMATED SOFTWARE CLOSURE OF PAYLOAD BAY DOORS, IF SWITCH MODULE ARM IS PREMATURELY ACTIVATED. THIS FAILURE WILL RESULT IN FAILURE TO ENGAGE BULKHEAD ROLLERS, INTERFERE WITH DOOR CLOSING AND CAUSE DAMAGE TO DOOR WHEN CENTERLINE LATCHES ARE CLOSED. FAILURE OF ONE INDIVIDUAL LIMIT SWITCH RESULTS IN NEED FOR MANUAL SOFTWARE OPERATION.
 (C) ENTRY MAY PROCEED WITH ANY ONE OF FOUR BULKHEAD LATCH GANGS DISENGAGED, PROVIDED CENTERLINE LATCHES ARE LATCHED, REF. JSC08934.
 (D) POSSIBLE DAMAGE TO VEHICLE. POSSIBLE LOSS OF CREW/VEHICLE IF MORE THAN ONE BULKHEAD LATCH GANG IS NOT LATCHED OR IF CENTERLINE LATCHES FAIL TO LATCH.

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SUBSYSTEM :ACTUATION MECH-PBD

FMEA NO 02-4B -140 -2 REV:02/08/88

DISPOSITION & RATIONALE:

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

(A) DESIGN

ACTUATOR ARM, IS PHYSICALLY LOCATED SO AS TO MINIMIZE POSSIBILITY OF DAMAGE WHILE ON ORBIT. EXPECTED CREW MONITORING OF DOOR CLOSURE PROVIDES DETECTION AND WORKAROUND CAPABILITY. INSTALLATION AND ADJUSTMENT OF MODULE CONTROLLED (MLO308-0022). SHIFTING FOLLOWING INSTALLATION PROTECTED AGAINST- CONTROLLED TORQUE, SERRATED WASHERS USED, FASTENERS LOCKWIRED. THE AFT BULKHEAD INCORPORATES ALIGNMENT STRIPES. DESIGN PERMITS PARTIAL EXTRAVEHICULAR ACTIVITY (EVA) WORKAROUND IF PAYLOAD DOES NOT LIMIT ACCESS.

(B) TEST

QUALIFICATION TESTS: THE QUALIFICATION ACTUATOR IS CERTIFIED ACTUATOR IS CERTIFIED PER CR-27-287-0039-0001D (REF. FMEA/CIL 02-4B-007-3). THE PAYLOAD BAY DOOR MECHANISM CERTIFIED PER CR-29-594160-001D FOR FORWARD MECHANISM AND CR-29-59426-001E FOR AFT MECHANISM. SYSTEM QUALIFICATION TESTS ON 15 FOOT PAYLOAD BAY DOOR TEST ARTICLE (087) WITH SWITCH MODULES INCLUDED: ACCEPTANCE TO CONFIRM ALL COMPONENTS HAVE BEEN ASSEMBLED AND RIGGED PER MLO308-0022. THERMAL CYCLE TEST (THERMALLY 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 +15 DEG F AND +325 DEG F AT DOOR AND BETWEEN -180 DEG F AND +120 DEG F AT AFT BULKHEAD); (THE FORWARD LATCHES WERE CYCLED BETWEEN -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 BETWEEN -35 DEG F AND +60 DEG F AT BULKHEAD AND BETWEEN +40 DEG F AND +245 DEG F AT DOOR); 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 BULKHEADS 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.

OMRSD: GROUND TURNAROUND INCLUDES MONITORING FUNCTIONAL TESTS TO VERIFY PROPER OPERATION.

(C) INSPECTION

RECEIVING INSPECTION

RECEIVING INSPECTION VERIFIES MATERIAL AND PROCESS CERTIFICATIONS.

CONTAMINATION CONTROL

CORROSION PROTECTION IS VERIFIED BY INSPECTION. CLEANLINESS IS MAINTAINED PER APPLICATION SPECIFICATION, PRIOR TO ASSEMBLY, AND IS VERIFIED BY INSPECTION.

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ASSEMBLY/INSTALLATION

ALL DETAILS AND SUBASSEMBLIES ARE MANUFACTURED PER DRAWING AND APPLICABLE SPECIFICATIONS; VERIFIED BY INSPECTION ON MANUFACTURING ORDERS. ASSEMBLY OF MODULE AND INSTALLATION OF THREADED FASTENERS IS VERIFIED BY INSPECTION. ELECTRICAL COMPONENTS ENCAPSULATION AND INSTALLATION IS VERIFIED BY INSPECTION. ADJUSTMENT PROCEDURE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

X-RAY INSPECTION UNDER MINIMUM 7X MAGNIFICATION FOR EVIDENCE OF WELD FLASH, LOSS PARTS, AND ASSEMBLY ANOMALIES.

CRITICAL PROCESSES

CRITICAL PROCESSES INCLUDING WELDING, BRAZING, AND PASSIVATION ARE MONITORED AND VERIFIED BY INSPECTION.

TESTING

ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

CAR NO. 03F007 : WHEN THE LEFT-HAND PAYLOAD BAY DOOR WAS OPENED DURING STS-3 MISSION, THE SWITCH MODULE ON FORWARD BULKHEAD INDICATED "READY-TO-LATCH" AFTER THE DOOR WAS OPENED; FAILURE RESULTED FROM THE SWITCH ACTUATING ARM IN THE SWITCH MODULE WHICH HUNG-UP IN THE READY-TO-LATCH POSITION; SWITCH MODULES REPLACED AND REWORKED AND DRAWINGS WERE REVISED TO ENSURE ADEQUATE CLEARANCE FOR LEVER ARM TO PREVENT RECURRENCE OF THE SWITCH MODULE ACTUATING ARM HANG-UP AT LOW TEMPERATURE.

CAR NO. 31F001 : WHEN THE OV104 LEFT-HAND PAYLOAD BAY DOOR WAS OPENED ON ORBIT, ONE OF THREE READY-TO-LATCH SWITCHES IN THE LEFT-HAND AFT SWITCH MODULE INDICATED "READY-TO-LATCH" WITH THE DOOR OPEN; CAUSE OF THE HANG-UP WAS IMPROPER ADJUSTMENT OF STOP SETSCREWS AND SWITCH ACTUATION SETSCREWS IN THE SWITCH MODULE MECHANISM WHICH HAD INSUFFICIENT TRAVEL TO MODULE ARM WAS RELEASED; ADJUSTMENT PROCEDURES AND ACCEPTANCE TESTS REVISED TO ENSURE POSITIVE OVERTRAVEL AND SWITCH TRANSFER WITH THE SWITCH MODULE ARM IN FREE POSITION.

CAR NO. 31F002 : WHEN THE LEFT-HAND PAYLOAD BAY DOOR WAS OPENED ON ORBIT THE "DOOR CLOSED" SWITCH S4 IN THE LEFT-HAND FORWARD SWITCH MODULE CONTINUED TO INDICATE DOOR CLOSED; HANG-UP OF SWITCH S4 IN THE "DOOR CLOSED" POSITION WAS ATTRIBUTED TO ABSENCE OF LOCKING TORQUE IN THE STOP SETSCREW THREADED INSERT, COMBINED WITH IMPROPER ADJUSTMENT OF SETSCREWS SWITCH MODULE REPLACED AND REWORKED, ADJUSTMENT PROCEDURES REVISED TO ENSURE POSITIVE SWITCH TRANSFER AND OVERTRAVEL WITH THE SWITCH MODULE ARM IN FREE POSITION, AND REMOVED SWITCH MODULES WILL HAVE SETSCREW LOCKING TORQUES VERIFIED WITH SWITCHES READJUSTED AND SETSCREWS LOCKED WITH EPOXY.

(E) OPERATIONAL USE

SOFTWARE MANUAL MODE MUST BE USED TO OPERATE DOORS AND LATCHES.