

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : P/L RETEN & DEPLOY-MPM DEPLOY FMEA NO 02-5B-P07-3 REV:04/05/88

ASSEMBLY : MPM DEPLOYMENT MECHANISM

P/N RI : V082-544650

P/N VENDOR:

QUANTITY : 3

CRIT. FUNC: 1R

CRIT. HDW: 2

VEHICLE 102 103 104

EFFECTIVITY: X X X

PHASE(S): PL LO OO X DO X LS

REDUNDANCY SCREEN: A-PASS B-PASS C-PASS

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ITEM:

DRIVE LINKAGE, PEDESTAL

FUNCTION:

REDUNDANT POWER DRIVE UNIT (PDU) MOTORS DRIVE THROUGH TORQUE LIMITERS AND THE PDU GEARBOX TO PROVIDE TORQUE TO THE MANIPULATOR POSITIONING MECHANISM (MPM) DRIVESHAFT WHICH IN TURN DRIVES THE SHOULDER AND FORWARD/MID/AFT PEDESTAL ROTARY DRIVE GEARBOX/DRIVE LINKAGES.

FAILURE MODE:

PHYSICAL BINDING/JAMMING

CAUSE(S):

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

EFFECTS ON:

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

(A) FAILURE WILL RESULT IN LOSS OF ABILITY TO POSITION THE MPM. TORQUE WILL FEED BACK INTO SYSTEM AND SLIP THE TORQUE LIMITERS IN THE PDU.

(B) FAILURE WILL RESULT IN LOSS OF ABILITY TO POSITION MPM CAUSING POTENTIAL INTERFERENCE WITH PAYLOAD BAY (PLB) DOOR CLOSURE.

(C) FAILURE WILL RESULT IN POSSIBLE LOSS OF MISSION DUE TO BLOCKAGE OF PAYLOAD DEPLOYMENT/RETRIEVAL ENVELOPE OR INABILITY TO DEPLOY REMOTE MANIPULATOR SYSTEM (RMS).

(D) FAILURE WILL REQUIRE JETTISON OF MPM TO PREVENT POSSIBLE LOSS OF CREW/VEHICLE DUE TO INTERFERENCE WITH PLB DOOR CLOSURE.

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DISPOSITION & RATIONALE:

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

(A) DESIGN

COMPONENTS ON THE DRIVE LINKAGE ARE MADE OF HIGH STRENGTH, HEAT AND CORROSION RESISTANT MATERIAL (A-286 AND INCONEL 718). ALL COMPONENTS SHOW POSITIVE MARGINS BY ANALYSIS AND CARRY MINIMUM OF 1.4 SAFETY FACTOR. DUAL ROTATION SURFACES HAVE BEEN EMPLOYED ON PIVOT POINTS. DUAL DRIVE MOTORS AND LIMIT SWITCHES ARE USED FOR REDUNDANCY.

(B) TEST

QUALIFICATION TESTS: THE MPM DEPLOYMENT ACTUATOR MC287-0037-0006/-0007 IS CERTIFIED PER CR-29-287-0037-0001G (REF FMEA/CIL 02-5B-P01-3) THE MANIPULATOR POSITIONING MECHANISM INSTALLATION IS CERTIFIED PER CR-44-000002E. THE SYSTEM INSTALLATION QUALIFICATION TEST INCLUDED: ACCEPTANCE (TO CONFIRM ALL COMPONENTS HAVE BEEN ASSEMBLED AND RIGGED PER APPLICABLE DRAWINGS AND SPECIFICATIONS); FLIGHT VIBRATION - 20 TO 2,000 HZ RANGE WITH MAXIMUM OF 0.006 g²/HZ FROM 100 TO 250 HZ FOR 49.5 MINS/AXIS AT LEVEL "A", AND WITH MAXIMUM OF 0.047 g²/HZ FROM 50 TO 250 HZ FOR 49.5 MINS/AXIS AT LEVEL "B"; STIFFNESS TEST - APPLIED LOADS AND MOMENTS (11 CONDITIONS) TO THE SHOULDER MECHANISM (8 CONDITIONS) AND RETENTION FITTING (3 CONDITIONS); LIMIT LOAD - APPLIED LIMIT LOAD AND 115% OF LIMIT LOAD TO THE RETENTION FITTING AND SHOULDER MECHANISM (STOWED AND DEPLOYED POSITIONS); FUNCTIONAL CHECKOUT WITHOUT MANIPULATOR ARM - CYCLED MPM WITH BOTH MOTORS, 40 SEC MAX/DEPLOY STROKE AND 50 SEC MAX/STOWED STROKE; FUNCTIONAL CHECKOUT WITH MANIPULATOR ARM - CYCLED EACH RETENTION LATCH TO THE LATCHED AND UNLATCHED POSITION WITH BOTH MOTORS, 7.5 SEC MAX/LATCH AND UNLATCH STROKE AND REPEATED DEPLOY AND STOW CYCLES OF MPM.

QUAL TESTS ALSO INCLUDE: HORIZONTAL OPERATION - CYCLED 115 TIMES AT +70 DEG F, 60 TIMES AT +25 DEG F, 100 TIMES AT +168 DEG F WITH ENGINEERING ARM INSTALLED CYCLED 100 TIMES AT -100 DEG F AND 100 TIMES AT +250 DEG F WITHOUT THE ENGINEERING ARM INSTALLED; SEPARATION SHOULDER/PEDESTAL - PERFORMED 4 PYRO SEPARATIONS (2 FOR SHOULDER AND 2 FOR RETENTION FITTING); READY-TO-LATCH INDICATION - OPERATED STRIKER BAR 500 TIMES AT AMBIENT TEMPERATURE, 20 TIMES AT -50 DEG F, 500 TIMES AT -100 DEG F AND 500 TIMES AT +168 DEG F; LIMIT LOAD (LANDING CASE) - APPLIED LIMIT LOADS AND 115% LIMIT LOADS TO SHOULDER MECHANISM IN STOWED POSITION; MECHANICAL STOP TEST - THE MPM DRIVE MECHANISM WAS OPERATED INTO ITS STOPS TEN TIMES; DELTA QUAL TEST - WITH DOWEL PIN INSTALLED THE SHOULDER MECHANISM IN DEPLOYED POSITION WAS SUBJECTED TO LIMIT LOADS; VERTICAL OPERATIONS - CONDUCTED 75 CYCLES AT ROOM AMBIENT CONDITIONS; ULTIMATE LOADS - CONDUCTED ULTIMATE LOADS ON RETENTION FITTING AND ON SHOULDER MECHANISM; PYRO SEPARATION - WITH DOWEL PIN INITIATED PYRO SEPARATION.

ACCEPTANCE TESTS: THE MPM ACCEPTANCE TEST CONSISTED OF CONFIRMATION OF ACCEPTANCE DATA APPLICABLE TO ASSEMBLY AND RIGGING.

OMRSD: GROUND TURNAROUND INCLUDES MPM DEPLOY (SYSTEM 1), MPM STOW (SYSTEM 1), MPM DEPLOY (SYSTEM 2), AND MPM STOW (SYSTEM 2).

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(C) INSPECTION

RECEIVING INSPECTION

MATERIAL AND PROCESS CERTIFICATIONS ARE VERIFIED BY RECEIVING INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS IS MAINTAINED PER APPLICABLE SPECIFICATION AND VERIFIED BY INSPECTION. CORROSION PROTECTION IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

DETAILS ARE MACHINED PER SPECIFICATION AND DETAIL MANUFACTURING PLANNING DOCUMENT VERIFIED BY INSPECTION. DETAILS REQUIRING BEARING INSTALLATIONS AND SPLINE ORIENTATION ON REQUIRED DETAILS IS PER DATA BLOCK ON DRAWING ARE VERIFIED BY INSPECTION. ELECTRICAL CONTINUITY, RIGGING OPERATIONS AND CAUTION NOTES RELATIVE TO RIGGING AND ADJUSTMENTS ARE VERIFIED BY INSPECTION. THREADED FASTENERS ARE INSTALLED AND TORQUED PER SPECIFICATION.

NONDESTRUCTIVE EVALUATION

PENETRANT INSPECTION IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

HEAT TREAT AND DRY FILM LUBE PER REQUIREMENTS ARE VERIFIED BY INSPECTION.

TESTING

ATP IS OBSERVED AND VERIFIED PER PROCEDURE INCLUDING BEARING PROOF LOAD.

HANDLING/PACKAGING

PARTS ARE PACKAGED PER APPLICABLE SPECIFICATION AND 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

THE MPM MAY BE JETTISONED IF PREVENTING PAYLOAD BAY DOOR CLOSURE,