SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :P/L RETEN & DEPLOY-MPM DEPLOY FMEA NO 02-5B-P08-1 REV:04/05/86

ASSEMBLY :MPM DEPLOYMENT MECHANISM
P/N RI :V082-544600
P/N VENDOR:
QUANTITY :1

CRIT. FUNC: 1
CRIT. HDW: 1

VEHICLE EFFECTIVITY:	102	103	104
	X	X	X

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

REDUNDANCY SCREEN: A- B- C-

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ITEM:
MECHANISM ASSEMBLY, SHOULDER

FUNCTION:
SHOULDER HOOK LATCHES TO PRIMARY STRUCTURE TO PROVIDE A LOAD CARRYING PATH FOR LOADED REMOTE MANIPULATOR SYSTEM (RMS) OPERATIONS. THE SHOULDER MECHANISM ASSEMBLY INCLUDES THE SHOULDER HOOK, LATCH ROLLER, SUPPORT BRACES, AND SHOULDER BASE PIVOT.

FAILURE MODE:
STRUCTURAL FAILURE

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,B) THE FAILURE WILL RESULT IN A LOSS OF ABILITY TO RESTRAIN THE SHOULDER MANIPULATOR POSITIONING MECHANISM (MPM) (BREAK IN PRIMARY LOAD PATH) AND, DURING RMS OPERATIONS, WILL RESULT IN UNCOMMANDED MOTION DUE TO THE UNCONSTRAINED SHOULDER MPM. ENSUING FAILURE OF THE SHOULDER DRIVE LINKAGES WILL OCCUR. ALL FAILURES MAY OCCUR IN SUCH A MANNER THAT POSITION LIMIT SWITCHES STILL INDICATE DESIRED POSITION OF MPM (MAY MAINTAIN OR GET STOW/DEPLOY INDICATIONS AT EXPECTED TIMES DESPITE FAILURE).

(C) FAILURE WILL RESULT IN POSSIBLE LOSS OF MISSION DUE TO LOSS OF RMS CAPABILITY.

(D) FAILURE WILL RESULT IN UNCOMMANDED AND UNCONTROLLED MOTION OF THE SHOULDER MPM/RMS/PAYLOAD SYSTEM AND POSSIBLE ORBITER CONTACT DAMAGE. FAILURE MAY REQUIRE IMMEDIATE JETTISON OF MPM TO PREVENT LOSS OF CREW/VEHICLE DUE TO ORBITER CONTACT DAMAGE.

SUBSYSTEM :P/L RETEN & DEPLOY-MPM DEPLOY FMEA NO 02-5B-P08-1 REV:04/05/88

DISPOSITION & RATIONALE:
(A)DESIGN (B)TEST (C)INSPECTION (D)FAILURE HISTORY (E)OPERATIONAL USE

(A) DESIGN
SHOULDER SUPPORT AND LINKAGE DESIGNED TO A FACTOR OF SAFETY OF 1.4 MINIMUM. HOOK RETAINS SHOULDER SUPPORT IN DEPLOYED POSITION FOR ADDITIONAL STRENGTH/STIFFNESS.

(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 (31 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 MONITORING FUNCTIONAL TEST TO VERIFY THAT MECHANISM OPERATES SATISFACTORILY.

(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, ELECTRICAL CONTINUITY, AND RIGGING OPERATIONS VERIFIED BY INSPECTION. SPLINE ORIENTATION ON REQUIRED DETAILS IS PER DATA BLOCK ON DRAWING 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 BY INSPECTION 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
ANY/ALL MPM MAY BE JETTISONED IF REQUIRED.