

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : P/L RETEN & DEPLOY-MPM DEPLOY FMEA NO 02-5B-P05-1 REV:07/28/

ASSEMBLY : MPM DEPLOYMENT MECHANISM
P/N RI : V082-544900
P/N VENDOR:
QUANTITY : 24

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

CRIT. FUNC: 1R
CRIT. HDW: 2

PREPARED BY:
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REDUNDANCY SCREEN: A-PASS B-PASS C-PAS
APPROVED BY:
DES *[Signature]* APPROVED BY (NASA):
REL *[Signature]* SSH *[Signature]*
QE *[Signature]* REL *[Signature]*
QE *[Signature]* QET *[Signature]*

ITEM:
DRIVESHAFT

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. 24 DRIVESHAFT SEGMENTS ARE USED FOR EACH REMOTE MANIPULATOR SYSTEM (RMS) INSTALLATION

FAILURE MODE:
STRUCTURAL FAILURE

CAUSE(S):
ADVERSE TOLERANCES/WEAR, CORROSION, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, EXCESSIVE LOAD, FATIGUE

EFFECTS ON:

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

(A) FAILURE WILL RESULT IN LOSS OF TORQUE AT THE LOCATION OF THE BREAK.

(B) FAILURE WILL RESULT IN LOSS OF ABILITY TO POSITION MPM DOWNSTREAM OF THE BREAK 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 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

DRIVESHAFTS ARE MADE OF HIGH STRENGTH CORROSION RESISTANT MATERIAL FOR HIGH TEMPERATURE SPACE ENVIRONMENT (A-286). IT SHOWS POSITIVE STRUCTURE MARGIN BY ANALYSIS AND MEETS 1.4 MINIMUM OF FACTOR OF SAFETY. EXTERNAL SPLINE FOR THE GEARING MECHANISM IS USED FOR MOTOR INPUT DRIVE.

(B) TEST

QUALIFICATION TESTS: THE MPM DEPLOYMENT ACTUATOR MC287-0037-0006/-000 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 MOMENT (11 CONDITIONS) TO THE SHOULDER MECHANISM (8 CONDITIONS) AND RETENTION FITTING (3 CONDITIONS); LIMIT LOAD - APPLIED LIMIT LOAD AND 115% OF LI LOAD TO THE RETENTION FITTING AND SHOULDER MECHANISM (STOWED AND DEPLOY 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 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 + 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 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 LOAD AND 115% LIMIT LOADS TO SHOULDER MECHANISM IN STOWED POSITION; MECHANISM 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 (SYSTEMS 1 AND 2) AND MPM STOW (SYSTEMS 1 AND 2).

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(C) INSPECTION

RECEIVING INSPECTION

MATERIAL AND PROCESS CERTIFICATIONS ARE VERIFIED BY RECEIVING INSPECTION.

CONTAMINATION CONTROL

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

ASSEMBLY/INSTALLATION

MATERIAL USED FOR FABRICATION OF SHAFT IS VERIFIED BY INSPECTION ON MANUFACTURING ORDERS. MACHINE TOLERANCES ARE PER DRAWING AND MACHINING SPECIFICATION. SPECIAL CALLOUT FOR SPLINE MACHINING IS FLAGGED OUT ON DRAWING DATA BLOCK, AND KEYWAY SLOT CLOSE TOLERANCE ARE VERIFIED BY INSPECTION. TORQUE REQUIREMENTS AND COMPLETE ASSEMBLY ARE VERIFIED BY INSPECTION. INSTALLATION OF THREADED FASTENERS IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PENETRANT INSPECTION IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

HEAT TREATING IS VERIFIED BY INSPECTION.

TESTING

ATP IS OBSERVED AND VERIFIED PER PROCEDURE.

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 PREVENTING PLB DOOR CLOSURE.