

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : P/L RETEN & DEPLOY-MPM DEPLOY FMEA NO 02-5B-P03-2 REV:04/05/88

ASSEMBLY :MPM SHOULDER/PEDESTAL DEPLOY MECH				CRIT. FUNC: 1R
P/N RI :MC147-0016-0003				CRIT. HDW: 2
P/N VENDOR:181780-3 CURTISS-WRIGHT	VEHICLE	102	103	104
QUANTITY :4	EFFECTIVITY:	X	X	X
	PHASE(S):	PL	LC	OO X DO X LS

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

PREPARED BY:		APPROVED BY:		APPROVED BY (NASA):
DES D. S. CHEUNG		DES <i>DSC FOR S. Campbell</i>		SSM <i>[Signature]</i>
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ITEM:

GEARBOX, ROTARY DRIVE

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:

FAILS FREE

USE(S):

EXCESSIVE LOAD, FAILURE/DEFLECTION OF INTERNAL PART, FATIGUE, VIBRATION

EFFECTS ON:

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

(A) THE FAILURE WILL RESULT IN A LOSS OF ABILITY TO POSITION THE AFFECTED MPM. OPERATION OF OTHER MPM WILL NOT BE AFFECTED. THE RMS WILL PULL THE FAILED MPM ALONG BUT THE FAILED MPM WILL NOT BE DRIVEN OVER-CENTER LOCKED AND POSITION LIMIT SWITCHES WILL NOT INDICATE STOWED/DEPLOYED. IF ANY MPM ARE OVER-CENTER LOCKED AT THE TIME OF FAILURE, THE MPM WILL APPEAR TO BE JAMMED.

(B) FAILURE WILL RESULT IN LOSS OF ABILITY TO POSITION AFFECTED MPM OVERCENTER LOCKED CAUSING POTENTIAL INTERFERENCE WITH RADIATOR DURING ENTRY.

(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).

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(D) FAILURE WILL RESULT IN POSSIBLE LOSS OF CREW/VEHICLE DUE TO UNRESTRAINED RMS/MPM MOTION DURING RE-ENTRY.

DISPOSITION & RATIONALE:

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

(A) DESIGN

ACTUATOR IS DESIGNED TO ACCEPT FULL POWER DRIVE UNIT (PDU) OUTPUT WITHOUT FAILURE. ULTIMATE LOAD = 1.4 TIMES LIMIT LOAD. GEARBOXES ARE DESIGNED TO PRECLUDE ENTRY OF FOREIGN MATERIALS, LOSS OF LUBRICANT AND JAMMING OF GEARS. DESIGN OF THE ACTUATION SYSTEM PERMITS EXTRAVEHICULAR ACTIVITY (EVA) CREW TO MANUALLY DRIVE MPM.

(B) TEST

QUALIFICATION TESTS: THE ACTUATOR IS CERTIFIED BY CR-29-147-0016-0001A. QUALIFICATION TESTS INCLUDE: ACCEPTANCE TEST TO CONFIRM ALL REQUIREMENTS SPECIFIED ON PARAGRAPH 4.2.2 OF PROCUREMENT SPEC ARE MET; VIBRATION TEST - 20 TO 2,000 HZ RANGE WITH MAXIMUM OF 1.0 g²/HZ FROM 200 TO 400 HZ FOR 5 MINUTES PER AXIS AT LEVEL "A" AND 0.6 g²/HZ FROM 200 TO 400 HZ FOR 34 MINUTES PER AXIS AT LEVEL "B"; THERMAL CYCLE - THE ACTUATOR IS THERMALLY CYCLED FIVE TIMES FROM +70 DEG F TO +330 DEG F TO +220 DEG F TO -100 DEG F TO -167 DEG F TO +70 DEG F. DWELL AT EACH TEMPERATURE WAS AT LEAST 60 MINUTES AFTER THERMAL STABILIZATION AT EACH -100 DEG F AND +220 DEG F. THE ACTUATOR WAS CYCLED TWICE WITH 50 INCH-LB INPUT; STOPS TEST THE ACTUATOR OPERATED AT 14.25 RPM AND NO LOAD INTO SIMULATED STRUCTURAL STOPS 100 TIMES IN EACH DIRECTION; FREEPLAY - THE ACTUATOR MOUNTED IN TEST FIXTURE WITH THE INPUT SHAFT FIXED WITH A TORQUE OF 100 INCH-LB APPLIED TO OUTPUT ARM; OPERATING LIFE TEST - THE ACTUATOR CYCLED 1,820 TIMES WITH A 50 INCH-LB INPUT; CERTIFICATION BY ANALYSIS/SIMILARITY - THESE INCLUDE: FUNGUS, OZONE, PACKAGING, ULTIMATE LOAD/LIMIT LOAD, TRANSIENT SHOCK, LANDING SHOCK AND DESIGN SHOCK, THERMAL VACUUM, HUMIDITY, AND ACCELERATION. THE ACTUATORS WERE SUBJECTED TO SYSTEM QUALIFICATION TESTS PER MANIPULATOR POSITIONING MECHANISM INSTALLATION V082-000002 (REF CR-44-000002-001E).

ACCEPTANCE TESTS: ACCEPTANCE TESTS INCLUDE: EXAMINATION OF PRODUCT - WEIGHT, WORKMANSHIP, DIMENSIONS, CONSTRUCTION, CLEANLINESS, FINISH, IDENTIFICATION MARKING, TRACEABILITY, AND USE OF APPROVED MATERIALS AND PROCESS; NO-LOAD DRIVING TEST - THE INPUT DRIVE SHAFT ROTATED SLOWLY TO DRIVE THE ACTUATOR THROUGH ITS FULL TRAVEL AND RETURN WITH NO LOAD ON THE OUTPUT. THE PEAK TORQUE DID NOT EXCEED 2.0 INCH-LB. FREEPLAY TEST - SEE QUALIFICATION TEST ABOVE; LOAD TEST - THE ROTARY ACTUATOR CYCLED 10 TIMES WITH A 75 INCH-LB INPUT; EFFICIENCY TEST - THE ACTUATOR WAS MOUNTED IN A TEST FIXTURE AND CYCLED 3 TIMES AGAINST A 500 INCH-LB LOAD. EFFICIENCY WAS CALCULATED WITH INPUT AND OUTPUT TORQUE MEASUREMENTS (INPUT TORQUE DID NOT EXCEED 17.1 INCH-LB).

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

MATERIALS CERTIFICATIONS ARE VERIFIED BY INSPECTION. ALL PURCHASED PARTS DATA PACKAGES INSPECTED BY RECEIVING INSPECTION.

CONTAMINATION CONTROL

SUPPLIER CONTAMINATION CONTROL AND CORROSION PROTECTION PROVISIONS VERIFIED BY INSPECTION. CLEANLINESS PER SPECIFICATION TO LEVEL 300 OF MA0110-301 VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

ALL MACHINED PARTS ARE DEBURRED AND VERIFIED PER DRAWING REQUIREMENTS. INSTALLATION PROCEDURE VERIFIED BY INSPECTION. DEFENSE CONTRACT ADMINISTRATION SERVICES (DCAS) MANDATORY INSPECTION POINTS (MIPS) IMPOSED ON MANUFACTURING, INSTALLATION, AND ASSEMBLY OF ACTUATORS. ROCKWELL HARDNESS VERIFIED ON GEARS. BEARING LUBRICATION AND SEAL INSTALLATION VERIFIED BY INSPECTION. GEARS ARE SHOT PEENED TO PRECLUDE FATIGUE.

NONDESTRUCTIVE EVALUATION

MAGNETIC PARTICLE INSPECTION IS VERIFIED BY INSPECTION AT THE DETAIL LEVEL.

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 REQUIRED FOR ENTRY.