

CRITICAL ITEMS LIST

AS.

LATURE: END EFFECTOR

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E1470-18-3

SHEET: 1

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1R CRITICALITY RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
3620	2	MOTOR MODULE ASSEMBLY QTY-1 P/N 51140E1473 OR 51140E2203	MODE: REDUCED MOTOR TORQUE. CAUSE(S): (1) MOTOR WINDING OPEN CIRCUIT. (2) DEBRIS IN BEARING.	EE MAY NOT FULLY RIGIDIZE. APPROX. 50% TORQUE GENERATED. RIGIDIZE TIME MAY TAKE LONGER. ARM WILL STAY LIMP IF NO RIGID FLAG. WORST CASE ----- UNEXPECTED PAYLOAD MOTION. INCOMPLETE RIGIDIZATION. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING ----- 1) MANUAL EE MODE RELEASE. 2) BACKUP EE RELEASE.	DESIGN FEATURES ----- THE END EFFECTOR MOTOR IS A MAJOR BOUGHT-OUT-PART WHICH IS SUPPLIED BY HONEYWELL SPERRY CORPORATION AND MEETS OR EXCEEDS THE REQUIREMENTS OF SPECIFICATION SPAR-SG.446 FOR THE P/N 51140D575-1 AND SPAR-SG.1092 FOR P/N 51140D575-3 MOTORS THE MOTOR COMPRISES OF:- A MULTIPOLE ROTOR BUILT WITH "RARE EARTH" PERMANENT MAGNETS. A WOUND STATOR, CONSISTING OF 24 COILS WOUND IN GROUPS OF 8. THE 3 GROUPS ARE SYMMETRICALLY ARRANGED AND INSERTED IN 24 RADIAL SLOTS IN A LAMINATED STEEL CORE. THE ENDS OF THE 3 COIL GROUPS ARE JOINED AND CONNECTED TO TEFLON INSULATED LEAD WIRES TO FORM THE CONVENTIONAL "DELTA" CONFIGURATION. THE WINDING FEATURES THAT HELP PREVENT SHORT OR OPEN CIRCUITS ARE:- - INSULATION IS TO CLASS 185 (H) - WIRE USED IN HEAVY ML MAGNET WIRE. - COILS ARE BAKED TO STRESS RELIEVE COPPER AND INSULATION. - SLOTS HAVE POLYIMIDE LINER. - END WINDINGS ARE ENCLOSED IN FIBREGLASS COVERS. - WINDING IS VACUUM IMPREGNATED USING 100% SOLID EPOXY, THIS IMPARTS GOOD THERMAL AND MECHANICAL PERFORMANCE. BEARINGS ARE LOCATED IN NON-DEBRIS PRODUCING AREA OF ASSEMBLY. THE GREASE LUBRICANT USED IS BRAYCOTE 601 (FORMERLY 3L-38RP) WHICH HAS A PERFLUORINATED POLYETHER OIL BASE WHICH IS VERY STABLE UNDER VACUUM ENVIRONMENT. THE GREASE IS APPLIED IN PRECISE QUANTITY TO EACH BEARING. THE LIFE OF THE BEARING LUBRICATION HAS BEEN ANALYZED USING ULTIMATE LOADS TO EVALUATE HERTZIAN STRESSES. ULTIMATE LOAD = 1.4 X WORKING LOAD. THE LUBRICANT ON ALL BEARINGS IS GOOD FOR OVER 400 MISSIONS USING THE ULTIMATE LOADS. THE END EFFECTOR PRIME AND BACK-UP RELEASE CLUTCH DESIGNS UTILIZE THREE BEARINGS, TWO OF WHICH ARE IDENTICAL. THE BEARINGS ARE PERMANENTLY LUBRICATED WITH WET LUBRICANT. THE TWO IDENTICAL BEARINGS ARE SEALED WITH TEFLON SEALS AND THE OTHER IS SEALED WITH TEFLON COATED FIBREGLASS SEALS, BOTH SIDES, TO PREVENT THE INGRESS OF DEBRIS.

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SHEET: 2

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
3620	2	MOTOR MODULE ASSEMBLY QTY-1 P/N 51140E1473 OR 51140E2203	<p>MODE: REDUCED MOTOR TORQUE.</p> <p>CAUSE(S): (1) MOTOR WINDING OPEN CIRCUIT. (2) DEBRIS IN BEARING.</p>	<p>EE MAY NOT FULLY RIGIDIZE. APPROX. 50% TORQUE GENERATED. RIGIDIZE TIME MAY TAKE LONGER. ARM WILL STAY LIMP IF NO RIGID FLAG.</p> <p>WORST CASE ----- UNEXPECTED PAYLOAD MOTION. INCOMPLETE RIGIDIZATION. CREW ACTION REQUIRED.</p> <p>REDUNDANT PATHS REMAINING ----- 1) MANUAL EE MODE RELEASE. 2) BACKUP EE RELEASE.</p>		<p>ACCEPTANCE TESTS ----- THE EE ASSEMBLY IS TESTED TO THE FOLLOWING ACCEPTANCE ENVIRONMENTS:</p> <p>O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 7</p> <p>O THERMAL VACUUM: +70 DEGREES C TO -25 DEGREES C (1 1/2 CYCLES) 1 X 10**6 TORR</p> <p>THE EE ASSEMBLY IS FURTHER TESTED IN THE IN THE RMS SYSTEM TEST (TP518 RMS STRONGBACK AND TP552 FLAT FLOOR TESTS) WHICH VERIFIES THE ABSENCE OF THE FAILURE MODE.</p> <p>QUALIFICATION TESTS ----- THE EE ASSEMBLY QUALIFICATION TESTING CONSISTED OF THE FOLLOWING ENVIRONMENTS:</p> <p>O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 7</p> <p>O SHOCK: 20G/11 MS - 3 AXES (6 DIRECTIONS)</p> <p>O THERMAL VACUUM: +81 DEGREES C TO -36 DEGREES C (6 CYCLES) 1 X 10**6 TORR</p> <p>O HUMIDITY: 95% RH (65 DEGREES C MAINTAINED FOR 6 HRS) (65 DEGREES C TO 30 DEGREES C IN 16 HRS) 10 CYCLES 240 HRS.</p> <p>O EMC: MIL-STD-461A AS MODIFIED BY SL-E-0002 (TEST CE01, CE03, CS01, CS02, CS06, RE02 (N/B))</p> <p>O STRUCTURAL STIFFNESS AND LOAD TEST</p> <p>FLIGHT CHECKOUT ----- PDRS OPS CHECKLIST (ALL VEHICLES) JSC 16987</p>

PREPARED BY:

MFVG

SUPERCEDING DATE: 06 OCT 87

APPROVED BY: _____

DATE: 24 JUL 91

CIL REV: 2

CRITICAL ITEMS LIST

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SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1470-1E-3

SHEET: 3

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3620	2	MOTOR MODULE ASSEMBLY QTY-1 P/N 51140E1473 OR 51140E2203	<p>MODE: REDUCED MOTOR TORQUE.</p> <p>CAUSE(S): (1) MOTOR WINDING OPEN CIRCUIT. (2) DEBRIS IN BEARING.</p>	<p>EE MAY NOT FULLY RIGIDIZE. APPROX. 50% TORQUE GENERATED. RIGIDIZE TIME MAY TAKE LONGER. ARM WILL STAY LIMP IF NO RIGID FLAG.</p> <p>WORST CASE ----- UNEXPECTED PAYLOAD MOTION. INCOMPLETE RIGIDIZATION. CREW ACTION REQUIRED.</p> <p>REDUNDANT PATHS REMAINING ----- 1) MANUAL EE MODE RELEASE. 2) BACKUP EE RELEASE.</p>	<p>QA/INSPECTIONS -----</p>	<p>UNITS ARE MANUFACTURED UNDER DOCUMENTED QUALITY CONTROLS. THESE CONTROLS ARE EXERCISED THROUGHOUT DESIGN PROCUREMENT, PLANNING, RECEIVING, PROCESSING, FABRICATION, ASSEMBLY, TESTING AND SHIPPING OF THE UNITS. MANDATORY INSPECTION POINTS ARE EMPLOYED AT VARIOUS STAGES OF FABRICATION ASSEMBLY AND TEST. GOVERNMENT SOURCE INSPECTION IS INVOKED AT VARIOUS CONTROL LEVELS.</p> <p>WIRE IS PROCURED TO SPECIFICATION MIL-W-22759 OR MIL-W-81381 AND INSPECTED AND TESTED TO NASA JSCB080 STANDARD NUMBER 95A.</p> <p>RECEIVING INSPECTION VERIFIES THAT THE HARDWARE RECEIVED IS AS IDENTIFIED IN THE PROCUREMENT DOCUMENTS, THAT NO DAMAGE HAS OCCURRED DURING SHIPMENT, AND THAT APPROPRIATE DATA HAS BEEN RECEIVED WHICH PROVIDES ADEQUATE TRACEABILITY INFORMATION AND IDENTIFIES ACCEPTABLE PARTS.</p> <p>PARTS ARE INSPECTED THROUGHOUT MANUFACTURE AND ASSEMBLY AS APPROPRIATE TO THE MANUFACTURING STAGE COMPLETED. THESE INSPECTIONS INCLUDE,</p> <p>MAGNET WIRE IS PROCURED TO MIL-W-583 AND CHECKED AT INCOMING INSPECTION PER FEDERAL STANDARD J-W-1177 WHICH INCLUDES DIELECTIC, PIN HOLES, BUBBLES, BLISTERS, AND CRACKS IN THE INSULATION.</p> <p>ALL SOLDERING IS ACCOMPLISHED BY OPERATORS, WHO ARE TRAINED AND CERTIFIED TO NASA MHB5300.4(3A) STANDARD, AS MODIFIED BY JSC 08800A.</p> <p>BEARINGS RECEIVE DIMENSIONAL INSPECTION AT THE SUPPLIER AND VERIFICATION BY SPAR RECEIVING INSPECTION. PRE-ASSEMBLY INSPECTION VERIFIES CIRCULARITY OF BALL TRACKS AND INNER/OUTER RACE DIAMETERS. AFTER ASSEMBLY PRIOR TO LUBRICATION, RADIAL CLEARANCE MEASUREMENTS ARE TAKEN. FOLLOWING LUBRICATION, RUN-IN/BURNISHING AND CLEANING OF DRY LUBE BEARINGS, SPECIALIZED BEARING INSPECTION EQUIPMENT AT SPAR IS USED TO VERIFY QUALITY AND STICTION LEVELS THROUGH STRIP CHART RECORDING OF TORQUE TRACES. BEARINGS ARE THEN RETURNED TO THE SUPPLIER FOR FINAL RADIAL CLEARANCE MEASUREMENTS. GOVERNMENT SOURCE INSPECTION IS ENVOCKED ON ALL BEARING PROCUREMENTS.</p> <p>UNITS ARE INSPECTED TO THE APPLICABLE SPAR INSPECTION TEST PROCEDURE (ITP). INSPECTIONS INCLUDE, CLEANLINESS USING UV., GENERAL WORKMANSHIP, DIMENSIONAL, IDENTIFICATION, LEAD CONFIGURATION, CONTINUITY CHECK ETC.</p> <p>INTEGRATION OF UNIT TO MOTOR MODULE - INSPECTIONS INCLUDE GROUNDING CHECKS, CONNECTOR FOR BENT PINS, VISUAL, CLEANLINESS, INTERCONNECT WIRING ETC.</p> <p>INSPECTION VERIFIES THAT KITTED PARTS ARE CORRECT PRIOR TO ASSEMBLY AND TRACEABILITY INFORMATION RECORDED.</p> <p>INSPECTION TO DRAWING IS CONDUCTED THROUGHOUT THE ASSEMBLY</p>

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SHEET: 4

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3620	2	MOTOR MODULE ASSEMBLY QTY-1 P/N 51140E1473 OR 51140E2203	MODE: REDUCED MOTOR TORQUE. CAUSE(S): (1) MOTOR WINDING OPEN CIRCUIT. (2) DEBRIS IN BEARING.	EE MAY NOT FULLY RIGIDIZE. APPROX. 50% TORQUE GENERATED. RIGIDIZE TIME MAY TAKE LONGER. ARM WILL STAY LIMP IF NO RIGID FLAG. WORST CASE ----- UNEXPECTED PAYLOAD MOTION. INCOMPLETE RIGIDIZATION. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING ----- 1) MANUAL EE MODE RELEASE. 2) BACKUP EE RELEASE.		PROCESS, INCLUDING INSPECTION OF LOCKING, WITNESSING OF TORQUING AND APPLICATION OF TORQUE STRIPING. MOTOR MODULES ARE TESTED TO THE REQUIREMENTS OF SPAR-TM.1624 WHICH INCLUDES CONTINUITY AND ISOLATION CHECKS, STICTION, COMMUTATOR TIMING, AMBIENT AND THERMAL TESTING. (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT). INTEGRATION OF MOTOR MODULE TO END EFFECTOR LRU - INSPECTIONS INCLUDE GROUNDING CHECKS, CONNECTORS FOR BENT OR PUSHBACK CONTACTS, INCONNECT WIRING ETC. PRE-ACCEPTANCE TEST INSPECTION, WHICH INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC., (MANDATORY INSPECTION POINT). A TEST READINESS REVIEW (TRR) WHICH INCLUDES VERIFICATION OF TEST PERSONNEL, TEST DOCUMENTS, TEST EQUIPMENT CALIBRATION/ VALIDATION STATUS AND HARDWARE CONFIGURATION IS CONVENED BY QUALITY ASSURANCE IN CONJUNCTION WITH ENGINEERING, RELIABILITY, CONFIGURATION CONTROL, SUPPLIER AS APPLICABLE, AND THE GOVERNMENT REPRESENTATIVE, PRIOR TO THE START OF ANY FORMAL TESTING (ACCEPTANCE OR QUALIFICATION). ACCEPTANCE TESTING (ATP) INCLUDES, AMBIENT, VIBRATION AND THERMAL-VAC TESTING, (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT) SRMS SYSTEMS INTEGRATION, THE INTEGRATION OF MECHANICAL ARM SUBASSEMBLIES AND THE FLIGHT CABIN EQUIPMENT TO FORM THE SRMS. INSPECTIONS ARE PERFORMED AT EACH PHASE OF INTEGRATION WHICH INCLUDES GROUNDING CHECKS, THRU WIRING CHECKS, WIRING ROUTING, INTERFACE CONNECTORS FOR BENT OR PUSH BACK CONTACTS ETC. SRMS SYSTEMS TESTING - STRONGBACK AND FLAT FLOOR AMBIENT PERFORMANCE TEST. (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT)

PREPARED BY:

MFVG

SUPERCEDING DATE: 06 OCT 87

APPROVED BY: _____

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CIL REV: 2

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SHEET: 5

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PREPARED BY: MFVG SUPERCEDING DATE: 06 OCT 87 APPROVED BY: _____ DATE: 24 JUL 91 CIL REV: 2