

CRITICAL ITEMS LIST

PROJECT: SRMS (-5 NCIU INSTALLED)
 ASS'Y NOMENCLATURE: ROTOR MODULE

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E1214

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
4135	0	TACHOMETER QTY-6 51140C1272	<p>MODE: LOSS OF TACHO OUTPUT.</p> <p>CAUSE(S): (1) OPEN OR SHORTED ROTOR OR TRANSFORMER WINDING. (2) OPEN OR SHORTED SINE OR COSINE OR TRANSFORMER STATOR WINDING. (3) LOSS OF EXCITATION SUPPLY.</p>	<p>NO RATE FEEDBACK. LOSS OF ALL COMPUTER SUPPORTED MODES. JOINT WILL RUNAWAY. AUTO BRAKES WILL BE INITIATED BY TACHO BITE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE.</p> <p>WORST CASE ----- UNEXPECTED MOTION. JOINT RUNAWAY. AUTO BRAKES.</p> <p>REDUNDANT PATHS REMAINING ----- AUTOBRAKES</p>	<p>DESIGN FEATURES -----</p> <p>THE TACHOMETER IS A MAJOR BOUGHT-OUT-PART WHICH IS SUPPLIED BY FARRAND CONTROLS LIMITED AND MEETS OR EXCEEDS THE REQUIREMENTS OF SPECIFICATION SPAR-SG.405.</p> <p>COPPER PATTERN PRINTED CIRCUIT IS INSULATED FROM TITANIUM BASE WITHIN 2 MIL. KAPTON AND 2 MIL. EPOXY 'B' STAGE ADHESIVE. CNC 19-2.</p> <p>ROTARY TRANSFORMER CORES HAVE 1 MIL. THICK EPOXY INSULATION, BONDED TO WINDING TROUGH.</p> <p>TRANSFORMER WINDINGS USE 30 AVG. MAGNET WIRE TO FEDERAL ST. J-W-1177.</p> <p>SOLDER CONNECTIONS TO PATTERN ARE PERFORMED AFTER A PREHEAT - THIS ELIMINATES TRACE LIFTING/SEPARATION.</p> <p>TRANSFORMER COILS AND ALL TACH INTERCONNECTIONS SECURED WITH EPOXY THAT IS APPLIED AND CURED UNDER VACUUM.</p> <p>PATTERN SURFACES ARE DOUBLE COATED WITH PARYLENE 'D' INSULATION AFTER CLEANING WHICH INCLUDES A 16 HOUR VACUUM BAKE @ 140 DEGREES C TO REMOVE FINAL TRACES OF RESINS FLUXES AND SOLVENTS.</p> <p>THE STATOR GOLD SHIELD IS APPLIED USING "FLASH COATING" METHOD WHICH COMMENCES WITH CHROME AND PASSES TO GOLD. THE FINAL THICKNESS BEING 2 X 10**6 INCH.</p> <p>THE TACH INPUT AND OUTPUT LEADS HAVE SEPARATE ELECTRIC AND MAGNETIC SHIELDS.</p> <p>TO LIMIT THE POSSIBILITY OF A LOSS OF INPUT VOLTAGE DUE TO AN OPEN LEAD WIRE ALL SOLDERING IS ACCOMPLISHED BY OPERATORS WHO ARE TRAINED AND CERTIFIED TO NASA WHB 5300.4 (3A) STANDARD, AS MODIFIED BY JSC 08800A.</p> <p>CONNECTOR USED ARE TO GSFC SPECIFICATION S.311.P.4/9.</p> <p>CONTACTS USED ARE TO GSF SPEC.S.311.P.4/9.</p> <p>CRIMPING IS CONTROLLED TO SPAR PPS 9:17 WHICH EMBODIES MSC-SPEC-Q-1A.</p> <p>COMPARATORS AND OPERATIONAL AMPLIFIERS ARE STANDARD LINEAR INTEGRATED CIRCUITS WITH MATURE MANUFACTURING TECHNOLOGY. APPLICATION CONSTRAINTS ARE IN ACCORDANCE WITH SPAR-RMS-PA.003.</p> <p>ALL RESISTORS AND CAPACITORS USED IN THE DESIGN ARE SELECTED FROM ESTABLISHED RELIABILITY (ER) TYPES. LIFE EXPECTANCY IS INCREASED BY ENSURING THAT ALL ALLOWABLE STRESS LEVELS ARE DERATED IN ACCORDANCE WITH SPAR-RMS-PA.003. ALL CERAMIC AND ELECTROLYTIC CAPACITORS ARE ROUTINELY SUBJECTED TO RADIOGRAPHIC INSPECTION.</p>

PREPARED BY: MFVG

SUPERCEDING DATE: NONE

DATE: 11 JUL 91

CIL REV: 0

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CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU INSTALLED)
 ASS'Y NOMENCLATURE: ROTOR MODULE

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E1214

SHEET: 2

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HWR / FUNC. 2/1R CRITICALITY RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
4135	0	TACHOMETER QTY-6 51140C1272	MODE: LOSS OF TACHO OUTPUT. CAUSE(S): (1) OPEN OR SHORTED ROTOR OR TRANSFORMER WINDING. (2) OPEN OR SHORTED SINE OR COSINE OR TRANSFORMER STATOR WINDING. (3) LOSS OF EXCITATION SUPPLY.	NO RATE FEEDBACK. LOSS OF ALL COMPUTER SUPPORTED MODES. JOINT WILL RUNAWAY. AUTO BRAKES WILL BE INITIATED BY TACHO BITE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. WORST CASE ----- UNEXPECTED MOTION. JOINT RUNAWAY. AUTO BRAKES. REDUNDANT PATHS REMAINING ----- AUTOBRAKES	THE DESIGN UTILIZES PROVEN CIRCUIT TECHNIQUES AND IS IMPLEMENTED USING CMOS LOGIC DEVICES. CMOS DEVICES OPERATE AT LOW POWER AND HENCE DO NOT EXPERIENCE SIGNIFICANT OPERATING STRESSES. THE TECHNOLOGY IS MATURE, AND DEVICE RELIABILITY HISTORY IS WELL DOCUMENTED. ALL STRESSES ARE ADDITIONALLY REDUCED BY DERATING THE APPROPRIATE PARAMETERS IN ACCORDANCE WITH SPAR-RMS-PA.003. SPECIAL HANDLING PRECAUTIONS ARE USED AT ALL STAGES OF MANUFACTURE TO PRECLUDE DAMAGE/STRESS DUE TO ELECTROSTATIC DISCHARGE.

PREPARED BY: MFNG

SUPERCEDING DATE: NONE

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CIL REV: 0

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CRITICAL ITEMS LIST

PROJECT: SRMS (-5 NCIU INSTALLED)
 ASS'Y NOMENCLATURE: MOTOR MODULE

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E12T4

SHEET: 3

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HMWR / FUNC. 2/1R CRITICALITY RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
4135	0	TACHOMETER QTY-6 51140C1272	MODE: LOSS OF TACHO OUTPUT. CAUSE(S): (1) OPEN OR SHORTED ROTOR OR TRANSFORMER WINDING. (2) OPEN OR SHORTED SINE OR COSINE OR TRANSFORMER STATOR WINDING. (3) LOSS OF EXCITATION SUPPLY.	NO RATE FEEDBACK. LOSS OF ALL COMPUTER SUPPORTED MODES. JOINT WILL RUNAWAY. AUTO BRAKES WILL BE INITIATED BY TACHO BITE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. WORST CASE UNEXPECTED MOTION. JOINT RUNAWAY. AUTO BRAKES. REDUNDANT PATHS REMAINING AUTOBRAKES	ACCEPTANCE TESTS ----- THE JOINTS MOTOR MODULE ASSEMBLY CONSIST OF THE BRAKE ASSEMBLY, MOTOR ASSEMBLY, TACHOMETER, COMM. SCANNER AND SCU ALL OF WHICH ARE EXPOSED TO AN ACCEPTANCE TEST BY THE VENDOR PRIOR TO ACCEPTANCE BY SPAR. THE MOTOR MODULE ASSEMBLY IS SUBJECTED TO THE FOLLOWING ACCEPTANCE ENVIRONMENT: O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 8 O THERMAL VACUUM: +85 DEGREES C TO -25 DEGREES C (1.5 CYCLES) 1 X 10**5 TORR THE MOTOR MODULE IS INSTALLED IN THE JOINTS ASSEMBLY AND AGAIN IS EXPOSED TO ANOTHER ACCEPTANCE TEST, WHICH INCLUDES VIBRATION AND THERMAL VACUUM OF THE SAME APPROXIMATE LEVEL AND DURATION. QUALIFICATION TESTS ----- A TYPICAL MOTOR MODULE ASSEMBLY WAS TOTALLY QUALIFIED BY SPAR FOR THE LISTED BELOW ENVIRONMENTS. FURTHER, THE BRAKE ASSEMBLY, MOTOR ASSEMBLY, TACHOMETER AND COMM. SCANNER, ARE SUBJECTED TO SOME DEGREE OF QUALIFICATION TESTING BY THE VENDOR. THE MOTOR MODULE TESTS: O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 8 O THERMAL VACUUM: +96 DEGREE C TO -36 DEGREE C (8 CYCLES) 1 X 10**6 TORR O SHOCK: 20G/11 MS - 3 AXES (6 DIRECTIONS) O HUMIDITY: TESTED IN SHOULDER JOINT HUMIDITY TEST O EMC: MIL-STD-461 AS MODIFIED BY SL-E-0002 (TESTS CS01, CS02, CS06, CE01, RE02(N/B), RS03, RS04) FLIGHT CHECKOUT ----- PDRS OPS CHECKLIST (ALL VEHICLES) JSC 16987

PREPARED BY:

MFWG

SUPERCEDING DATE: NONE

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 ASS'Y NOMENCLATURE: MOTOR MODULE

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E1214

SHEET: 4

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOWR / FUNC. 2/1R CRITICALITY RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
4135	0	TACHOMETER QTY-6 51140C1272	MODE: LOSS OF TACHO OUTPUT. CAUSE(S): (1) OPEN OR SHORTED ROTOR OR TRANSFORMER WINDING. (2) OPEN OR SHORTED SINE OR COSINE OR TRANSFORMER STATOR WINDING. (3) LOSS OF EXCITATION SUPPLY.	NO RATE FEEDBACK. LOSS OF ALL COMPUTER SUPPORTED MODES. JOINT WILL RUNAWAY. AUTO BRAKES WILL BE INITIATED BY TACHO BITE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. WORST CASE ----- UNEXPECTED MOTION. JOINT RUNAWAY. AUTO BRAKES. REDUNDANT PATHS REMAINING ----- AUTOBRAKES	QA/INSPECTIONS ----- UNITS ARE MAJOR BOUGHT OUT PARTS, MANUFACTURED, ASSEMBLED AND TESTED TO SPAR DRAWINGS AND SPECIFICATIONS UNDER DOCUMENTED QUALITY CONTROLS. THESE CONTROLS ARE EXERCISED THROUGHOUT DESIGN PROCUREMENT, PLANNING, PROCESSING, FABRICATION, ASSEMBLY QUALIFICATION AND ACCEPTANCE TESTING. MANDATORY INSPECTION POINTS ARE EMPLOYED AS APPROPRIATE AT VARIOUS LEVELS OF ASSEMBLY AND TEST. SPAR/GOVERNMENT SOURCE INSPECTION IS ENVOCKED ON THE SUPPLIER. WIRE IS PROCURED TO SPECIFICATION MIL-W-22759 OR MIL-W-81381 AND INSPECTED AND TESTED TO NASA JSCM8080 STANDARD NUMBER 95A. 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. PARTS ARE INSPECTED THROUGHOUT MANUFACTURE AND ASSEMBLY AS APPROPRIATE TO THE MANUFACTURING STAGE COMPLETED. THESE INSPECTIONS INCLUDE, 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. ALL SOLDERING IS ACCOMPLISHED BY OPERATORS, WHO ARE TRAINED AND CERTIFIED TO NASA NH85300.4(3A) STANDARD, AS MODIFIED BY JSC 08800A. PRINTED CIRCUIT BOARD INSPECTION FOR TRACK SEPARATION, DAMAGE AND ADEQUACY OF PLATED THROUGH HOLES, VISUAL INSPECTIONS VERIFY SHIELDS FOR PROPER BONDING, ANY DEFECTS SUCH AS HOLES OR BUMPS AND ROTOR COATING FOR DUST, BUBBLES AND SMOOTHNESS. UNITS ARE INSPECTED TO SPAR INSPECTION TEST PROCEDURE 11P266 PRIOR TO MOTOR MODULE INTEGRATION INSPECTIONS INCLUDE CLEANLINESS, ELECTRICAL CONTINUITY, ISOLATION RESISTANCE GENERAL WORKMANSHIP, GROUNDING MEASUREMENT AND TACHOMETER GAPPING. INTEGRATION OF UNIT TO MOTOR MODULE - INSPECTIONS INCLUDE GROUNDING CHECKS, CONNECTOR FOR BENT PINS, VISUAL, CLEANLINESS, INTERCONNECT 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,

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CRITICAL ITEMS LIST

PROJECT: SRMS (-5 HCUV INSTALLED)
 ASS'Y NOMENCLATURE: MOTOR MODULE

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E1216

SHEET: 5

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FWC. 2/1R CRITICALITY RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
4135	0	TACHOMETER QTY-6 51140C1272	MODE: LOSS OF TACHO OUTPUT. CAUSE(S): (1) OPEN OR SHORTED ROTOR OR TRANSFORMER WINDING. (2) OPEN OR SHORTED SINE OR COSINE OR TRANSFORMER STATOR WINDING. (3) LOSS OF EXCITATION SUPPLY.	NO RATE FEEDBACK. LOSS OF ALL COMPUTER SUPPORTED MODES. JOINT WILL RUNAWAY. AUTO BRAKES WILL BE INITIATED BY TACHO BITE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. WORST CASE ----- UNEXPECTED MOTION. JOINT RUNAWAY. AUTO BRAKES. REDUNDANT PATHS REMAINING ----- AUTOBRAKES	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) INTEGRATION OF UNIT TO JOINT SRU - INSPECTIONS INCLUDE GROUNDING CHECKS, CONNECTORS FOR BENT OR PUSHBACK CONTACTS, VISUAL, CLEANLINESS, INTERCONNECT WIRING AND POWER UP TEST TO THE APPROPRIATE JOINT INSPECTION TEST PROCEDURE (ITP) ETC. JOINT LEVEL PRE-ACCEPTANCE TEST INSPECTION, INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC. JOINT LEVEL ACCEPTANCE TESTING (ATP) INCLUDES AMBINET, 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: NFWG SUPERCEDING DATE: NONE

DATE: 11 JUL 91 CIU REV: 0

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CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU INSTALLED)
 ASS'Y NOMENCLATURE: MOTOR MODULE

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E1274

SHEET: 6

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDMR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
4135	0	TACHOMETER QTY-6 51140C1272	MODE: LOSS OF TACHO OUTPUT. CAUSE(S): (1) OPEN OR SHORTED ROTOR OR TRANSFORMER WINDING. (2) OPEN OR SHORTED SINE OR COSINE OR TRANSFORMER STATOR WINDING. (3) LOSS OF EXCITATION SUPPLY.	NO RATE FEEDBACK. LOSS OF ALL COMPUTER SUPPORTED MODES. JOINT WILL RUNAWAY. AUTO BRAKES WILL BE INITIATED BY TACHO BITE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. WORST CASE ----- UNEXPECTED MOTION. JOINT RUNAWAY. AUTO BRAKES. REDUNDANT PATHS REMAINING ----- AUTOBRAKES		FAILURE HISTORY ----- THERE HAVE BEEN NO FAILURES ASSOCIATED WITH THIS FAILURE MODE ON THE SRMS PROGRAM.

PREPARED BY: NFWG

SUPERCEDING DATE: NONE

RMS/MECH - 290

DATE: 11 JUL 91

CIL REV: 0

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CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU INSTALLED)
 ASS'Y NOMENCLATURE: MOTOR MODULE

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E1274

SHEET: 7

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
4135	0	TACHOMETER QTY-6 51140C1272	<p>MODE: LOSS OF TACHO OUTPUT.</p> <p>CAUSE(S): (1) OPEN OR SHORTED ROTOR OR TRANSFORMER WINDING. (2) OPEN OR SHORTED SINE OR COSINE OR TRANSFORMER STATOR WINDING. (3) LOSS OF EXCITATION SUPPLY.</p>	<p>NO RATE FEEDBACK. LOSS OF ALL COMPUTER SUPPORTED MODES. JOINT WILL RUNAWAY. AUTO BRAKES WILL BE INITIATED BY TACHO BITE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE.</p> <p>WORST CASE UNEXPECTED MOTION. JOINT RUNAWAY. AUTO BRAKES.</p> <p>REDUNDANT PATHS REMAINING AUTOBRAKES</p>		<p>OPERATIONAL EFFECTS ----- JOINT RUNAWAY. AUTOBRAKES. CANNOT USE COMPUTER SUPPORTED MODES. DIRECT DRIVE AND BACKUP AVAILABLE. ARM WILL NOT STOP AUTOMATICALLY IF AN UNDETECTED FAILURE OF THE AUTO BRAKES SYSTEM HAS PREVIOUSLY OCCURRED BRAKES CAN BE APPLIED MANUALLY.</p> <p>CREW HAS ABILITY TO OVERRIDE SINGLE FAILURE.</p> <p>CREW ACTION ----- APPLY BRAKES. USE DIRECT DRIVE.</p> <p>CREW TRAINING ----- THE CREW WILL BE TRAINED TO ALWAYS OBSERVE WHETHER THE ARM IS RESPONDING PROPERLY TO COMMANDS. IF IT ISN'T, APPLY BRAKES.</p> <p>MISSION CONSTRAINT ----- OPERATE UNDER VERNIER RATES WITHIN 10 FT OF STRUCTURE. THE OPERATOR MUST BE ABLE TO DETECT THAT THE ARM/PAYLOAD IS RESPONDING PROPERLY TO COMMANDS VIA WINDOW AND/OR CCTV VIEWS DURING ALL ARM OPERATIONS.</p> <p>OMRSD OFFLINE ----- IN COMPUTER SUPPORTED MODE WITH ELBOW DEMATED DRIVE ALL JOINTS. VERIFY JOINT MOTION.</p> <p>OMRSD ONLINE INSTALLATION ----- NONE</p> <p>OMRSD ONLINE TURNAROUND ----- IN SINGLE MODE DRIVE ALL JOINTS. VERIFY NO TACHOMETER BITE.</p>

PREPARED BY: MFWG SUPERCEDING DATE: NONE

DATE: 11 JUL 91

CIL REV: EXPEDITE PROCESSING

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