CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MECHANICAL ARM

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140J1565

SHEET: 1

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1RA CRITICALITY — RATIONALE FOR ACCEPTANCE SCREENS: A-FAIL, B-PASS, C-PASS
4020	1	OPTICAL POSITION ENCODER QTY-5 P/N 51140f680-3 AND QTY-1 P/N 511400231-3	MODE: LOSS OF SINGLE BIT OR ERRATIC OUTPUT. CAUSE(S): (1) INTERNAL PARTS FAILURE OF THE AMPLIFIER, SHIFT REGISTER, PHOTOCELL, OR COMPARATOR. (2) FUNGUS GROWTH ON DISC. (3) LOSS OF EEE PARTS.	POSITION ERROR OF ANY MAGNITUDE UP TO AND INCLUDING MSB. IF ERROR IS LARGE ENOUGH. SOFTWARE STOP MAY BE NON-FUNCTIONAL FOR FAILED JOINT. CONTROL ERROR AND AUTO BRAKES. IN AUTO, ARM WILL STOP, 0 RATE COMMANDED. ENCODER CHECK. IN DIRECT AND BACKUP MODES ARM WILL CONTINUE TO DRIVE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE . WORST CASE --- UNEXPECTED MOTION. INCORRECT POSITION DATA. AUTO BRAKES. REDUNDANT PATHS REMAINING --- AUTOBRAKES	DESIGN FEATURES --- THE JOINT AND WRIST ROLL OPTICAL POSITION ENCODERS ARE MAJOR BOUGHT-OUT-PARTS WHICH ARE SUPPLIED BY BEI MOTION SYSTEMS AND MEET OR EXCEED THE REQUIREMENTS OF SPECIFICATIONS SPAR-SG.466 AND SPAR-SG.421, RESPECTIVELY. THE PHOTOCELL IS ASSEMBLED AT BEI USING SPAR-APPROVED PROCEDURES. IT IS SCREENED AND QUALIFIED PER A BEI SCD TO STRESS LEVELS FAR IN EXCESS OF MISSION LIMITS. ALL EEE PARTS ARE PROCURED TO MILITARY SPECIFICATIONS OR EQUIVALENT. THE CIRCUITS EMBODY THE USE OF NHB5300.4(3A) SOLDERING, M38510 LEVEL B IC'S 2-SIDED PRINTED CIRCUIT BOARDS WITH NO PLATED-THU HOLES (Z WIRES USED WHERE NECESSARY) AND ALL LAP SOLDER JOINTS. THE EMI FILTER IS PURCHASED TO AN SCD (905-15181), WHICH INCORPORATES RESCREENING INCLUDING THERMAL SHOCK, BURN-IN, AND HERMITICITY TESTING, AS WELL AS X-RAY OF ALL UNITS. THE PHOTOEMULSION COATED DISK USED BY BEI TO ENCODE THE CYCLIC GRAY CODE PATTERN IS SLIGHTLY NUTRIENT TO FUNGUS GROWTH. THE DISK COMPARTMENT IS SUFFICIENTLY SEALED AS TO MAKE FUNGUS GROWTH VERY UNLIKELY.

PREPARED BY: MFWG

SUPERCEDING DATE: 11 SEP 86

DATE: 24 JUL 91

CIL REV: 1

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MECHANICAL ARM

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140J1585

SHEET: 2

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1RA CRITICALITY — RATIONALE FOR ACCEPTANCE SCREENS: A-FAIL, B-PASS, C-PASS
4020	1	OPTICAL POSITION ENCODER QTY-5 P/N 51140F680-3 AND QTY-1 P/N 511400231-3	MODE: LOSS OF SINGLE BIT OR ERRATIC OUTPUT. CAUSE(S): (1) INTERNAL PARTS FAILURE OF THE AMPLIFIER, SHIFT REGISTER, PHOTOCELL, OR COMPARATOR. (2) FUNGUS GROWTH ON DISC. (3) LOSS OF EEE PARTS.	POSITION ERROR OF ANY MAGNITUDE UP TO AND INCLUDING MSB. IF ERROR IS LARGE ENOUGH. SOFTWARE STOP MAY BE NON-FUNCTIONAL FOR FAILED JOINT. CONTROL ERROR AND AUTO BRAKES. IN AUTO, ARM WILL STOP, 0 RATE COMMANDED. ENCODER CHECK. IN DIRECT AND BACKUP MODES ARM WILL CONTINUE TO DRIVE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE . WORST CASE ---------- UNEXPECTED MOTION. INCORRECT POSITION DATA. AUTO BRAKES. REDUNDANT PATHS REMAINING ---------- AUTOBRAKES	ACCEPTANCE TESTS ---------- THE SHOULDER, ELBOW AND WRIST JOINTS ARE SUBJECTED TO THE FOLLOWING ACCEPTANCE ENVIRONMENTAL TESTING. O VIBRATION: LEVEL AND DURATION - REFERENCE TABLES 9, 10 AND 11. O THERMAL: +70 DEGREES C TO -25 DEGREES C (2 CYCLES) 1 X 10**6 TORR. THE JOINTS ARE INTEGRATED INTO THE RMS SYSTEM (PER TP532) WHICH IS FURTHER TESTED IN (TP518 RMS STRONGBACK AND TP552 FLAT FLOOR). THESE TESTS VERIFIES THE ABSENCE OF THE FAILURE MODE. QUALIFICATION TESTS ---------- THE SHOULDER AND WRIST JOINTS WERE SUBJECTED TO THE LISTED BELOW ENVIRONMENTS. THE ELBOW JOINTS WAS NOT EXPOSED THE QUALIFICATION ENVIRONMENTS WAS CERTIFIED BY SIMILARITY TO THE SHOULDER JOINT. O VIBRATION: LEVEL AND DURATION REFERENCE TABLES 9 AND 10 O SHOCK: 20G/11 MS - 3 AXES (6 DIRECTIONS) O THERMAL VACUUM: +81 DEGREES C TO -36 DEGREES C (6 CYCLES) 1 X 10**6 TORR. O EMC: MIL-STD-461 AS MODIFIED BY SL-E-0002 (TESTS CE01, CE03, CS01, CS02, CS06, RE02 (N/B). O HUMIDITY: ONLY SHOULDER JOINT WAS TESTED, 95% RH (65 DEGREES C MAINTAINED FOR 6 HRS.) (65 DEGREES C TO 30 DEGREES C IN 16 HRS) 10 CYCLES 240 HRS. O LOAD TEST: SHOULDER JOINT STRUCTURAL LOAD TEST REFERENCE TABLE 12. NOTE: ELBOW JOINT (S/N 302 AND UP) INCORPORATES NON-WELDED TRANSITIONS WHICH WAS LOAD TESTED TO LOAD IN REFERENCE TABLE TBS. FLIGHT CHECKOUT ---------- PDRS OPS CHECKLIST (ALL VEHICLES) JSC 16987

PREPARED BY: MFMG SUPERCEDING DATE: 11 SEP 86 APPROVED BY: _____ DATE: 24 JUL 91 CIL REV: 1

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ASS'Y NOMENCLATURE: MECHANICAL ARM
SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140J1565
SHEET: 3

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1RA CRITICALITY — RATIONALE FOR ACCEPTANCE SCREENS: A-FAIL, B-PASS, C-PASS
4020	1	OPTICAL POSITION ENCODER QTY-5 P/N 51140F680-3 AND QTY-1 P/N 511400231-3	MODE: LOSS OF SINGLE BIT OR ERRATIC OUTPUT. CAUSE(S): (1) INTERNAL PARTS FAILURE OF THE AMPLIFIER, SHIFT REGISTER, PHOTOCELL, OR COMPARATOR. (2) FUNGUS GROWTH ON DISC. (3) LOSS OF EEE PARTS.	POSITION ERROR OF ANY MAGNITUDE UP TO AND INCLUDING MSB. IF ERROR IS LARGE ENOUGH. SOFTWARE STOP MAY BE NON-FUNCTIONAL FOR FAILED JOINT. CONTROL ERROR AND AUTO BRAKES. IN AUTO, ARM WILL STOP, 0 RATE COMMANDED. ENCODER CHECK. IN DIRECT AND BACKUP MODES ARM WILL CONTINUE TO DRIVE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE . WORST CASE ---------- UNEXPECTED MOTION. INCORRECT POSITION DATA. 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 ENVOKED ON THE SUPPLIER. EEE PARTS INSPECTION IS PERFORMED AS REQUIRED BY SPAR-RMS-PA.003. EACH EEE PART IS QUALIFIED AT THE PART LEVEL TO THE REQUIREMENTS OF THE APPLICABLE SPECIFICATION. ALL EEE PARTS ARE 100% SCREENED AND BURNED IN, AS A MINIMUM, AS REQUIRED BY SPAR-RMS-PA.003, BY THE SUPPLIER. ADDITIONALLY, EEE PARTS ARE 100% RE-SCREENED IN ACCORDANCE WITH REQUIREMENTS, BY AN INDEPENDENT SPAR APPROVED TESTING FACILITY. DPA IS PERFORMED AS REQUIRED BY PA.003 ON A RANDOMLY SELECTED 5% OF PARTS, MAXIMUN 5 PIECES, MINIMUM 3 PIECES FOR EACH LOT NUMBER/DATE CODE OF PARTS RECEIVED. 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 ALL PARTS RECEIVED ARE AS IDENTIFIED IN THE PROCUREMENT DOCUMENTS, THAT NO PHYSICAL DAMAGE HAS OCCURRED TO PARTS DURING SHIPMENT, THAT THE RECEIVING DOCUMENTS PROVIDE ADEQUATE TRACEABILITY INFORMATION AND SCREENING DATA CLEARLY IDENTIFIES ACCEPTABLE PARTS. PARTS ARE INSPECTED THROUGHOUT MANUFACTURE AND ASSEMBLY AS APPROPRIATE TO THE MANUFACTURING STAGE COMPLETED. THESE INSPECTIONS INCLUDE, PRINTED CIRCUIT BOARD INSPECTION FOR TRACK SEPARATION, DAMAGED OR LIFTING CIRCUIT PADS, CLEANLINESS ETC. COMPONENT MOUNTING INSPECTION FOR CORRECT SOLDERING, WIRE LOOPING, STRAPPING, ETC. OPERATORS AND INSPECTORS ARE TRAINED AND CERTIFIED TO NASA NHB 5300.4(3A) STANDARD, AS MODIFIED BY JSC 08800A. CONFORMAL COATING INSPECTION FOR ADEQUATE PROCESSING IS PERFORMED USING ULTRAVIOLET LIGHT TECHNIQUES. P.C. BD. INSTALLATION INSPECTION, CHECK FOR CORRECT BOARD INSTALLATION, ALIGNMENT OF BOARDS, PROPER CONNECTOR CONTACT MATING, WIRE ROUTING, STRAPPING OF WIRES ETC., PRE-CLOSURE INSPECTION, WORKMANSHIP AND CLEANLINESS (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT) 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

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CRITICAL ITEMS LIST

PROGRAM: SRMS
ASSY NOMENCLATURE: MECHANICAL ARM

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140J1[illegible]

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1RA CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: A-FAIL, B-PASS, C-PASS
4020	1	OPTICAL POSITION ENCODER QTY-5 P/N 51140F680-3 AND QTY-1 P/N 511400231-3	MODE: LOSS OF SINGLE BIT OR ERRATIC OUTPUT. CAUSE(S): (1) INTERNAL PARTS FAILURE OF THE AMPLIFIER, SHIFT REGISTER, PHOTOCELL, OR COMPARATOR. (2) FUNGUS GROWTH ON DISC. (3) LOSS OF EEE PARTS.	POSITION ERROR OF ANY MAGNITUDE UP TO AND INCLUDING MSB. IF ERROR IS LARGE ENOUGH. SOFTWARE STOP MAY BE NON-FUNCTIONAL FOR FAILED JOINT. CONTROL ERROR AND AUTO BRAKES. IN AUTO, ARM WILL STOP, 0 RATE COMMANDED. ENCODER CHECK. IN DIRECT AND BACKUP MODES ARM WILL CONTINUE TO DRIVE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE . WORST CASE --------- UNEXPECTED MOTION. INCORRECT POSITION DATA. AUTO BRAKES. REDUNDANT PATHS REMAINING --------- AUTOBRAKES	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) 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. WIRE HARNESSES ARE INSPECTED DURING ASSEMBLY PROCESSES TO SPAR-ITP.251 AS REQUIRED BY SPECIFICATION SPAR-SG420. INSPECTIONS INCLUDE, CONTINUITY, LEAKAGE RESISTANCE, WIRE ROUTING, STRAIN RELIEF, LACING AND TIEDOWN 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)

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CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MECHANICAL ARM
SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140J1585

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1RA CRITICALITY RATIONALE FOR ACCEPTANCE SCREENS: A-FAIL, B-PASS, C-PASS
4020	1	OPTICAL POSITION ENCODER QTY-5 P/N 51140F680-3 AND QTY-1 P/N 511400231-3	MODE: LOSS OF SINGLE BIT OR ERRATIC OUTPUT. CAUSE(S): INTERNAL FAILURE OF THE AMPLIFIER, SHIFT REGISTER, PHOTOCELL, OR COMPARATOR. (2) FUNGUS GROWTH ON DISC. (3) LOSS OF EEE PARTS.	POSITION ERROR OF ANY MAGNITUDE UP TO AND INCLUDING MSB. IF ERROR IS LARGE ENOUGH. SOFTWARE STOP MAY BE NON-FUNCTIONAL FOR FAILED JOINT. CONTROL ERROR AND AUTO BRAKES. IN AUTO, ARM WILL STOP, 0 RATE COMMANDED. ENCODER CHECK. IN DIRECT AND BACKUP MODES ARM WILL CONTINUE TO DRIVE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE . WORST CASE --- UNEXPECTED MOTION. INCORRECT POSITION DATA. AUTO BRAKES. REDUNDANT PATHS REMAINING --- AUTOBRAKES	FAILURE HISTORY --- THE FOLLOWING FAILURE ANALYSIS REPORT(S) ARE RELEVANT: FAR 2069: S/N 212 MAY 79 DESCRIPTION --- GREY CODE OUTPUT INCCORRECT. FOUND FAULTY PHOTO-CELL WHICH DETERIORATED DUE TO THERMAL CYCLING. MIS-MATCH OF THERMAL EXPANSION CO-EFFICIENTS. REFER TO FAR 2070. CORRECTIVE ACTION --- RETROFIT ALL ENCODERS WITH DOW R6103 COATING. FAR 2102: S/N 203-7 FEB 80 DESCRIPTION --- UNIT STALLED DUE TO BROKEN PHOTO CELL BOND WIRES. REFER TO FAR 2069. CORRECTIVE ACTION --- REWORKED ALL CSA ASSYS. FAR 2070: S/N 209 MAY 79 DESCRIPTION --- GREY CODE OUT-PUT INCORRECT. REFER TO FAR 2069 CORRECTIVE ACTION --- REFER TO FAR 2069 FAR 2302: S/N 302 SEP 81 DESCRIPTION --- FAILED SEQUENCE TEST, CONTAMINATION ON OPTICAL DISC. CORRECTIVE ACTION --- IMPROVED CLEANING PROCESS. FAR 2308: S/N 306 DEC 81 DESCRIPTION

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PROJECT: SRMS
ASS'Y NOMENCLATURE: MECHANICAL ARM

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140J1565

SHEET: 6

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1RA CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: A-FAIL, B-PASS, C-PASS
4020	1	OPTICAL POSITION ENCODER QTY-5 P/N 51140F680-3 AND QTY-1 P/N 51140D231-3	MODE: LOSS OF SINGLE BIT OR ERRATIC OUTPUT. CAUSE(S): (1) INTERNAL PARTS FAILURE OF THE AMPLIFIER, SHIFT REGISTER, PHOTOCELL, OR COMPARATOR. (2) FUNGUS GROWTH ON DISC. (3) LOSS OF EEE PARTS.	POSITION ERROR OF ANY MAGNITUDE UP TO AND INCLUDING MSB. IF ERROR IS LARGE ENOUGH. SOFTWARE STOP MAY BE NON-FUNCTIONAL FOR FAILED JOINT. CONTROL ERROR AND AUTO BRAKES. IN AUTO, ARM WILL STOP, 0 RATE COMMANDED. ENCODER CHECK. IN DIRECT AND BACKUP MODES ARM WILL CONTINUE TO DRIVE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE . WORST CASE ---------- UNEXPECTED MOTION. INCORRECT POSITION DATA. AUTO BRAKES. REDUNDANT PATHS REMAINING ---------- AUTOBRAKES		---------- DID NOT SEQUENCE CORRECTLY, BIT COUNT FAILURE, POOR WORKMANSHIP LED INCORRECTLY MOUNTED EPOXY CONTAMINATED TRACK. CORRECTIVE ACTION ---------- CORRECTED FAULTS IMPROVED INSPECTION, CLEANINESS, TEMP TEST. FAR 2309 S/N 309 DEC 81 DESCRIPTION ---------- ERROR DURING ACCURACY TEST, 120 O PHASE INVERTED, POOR WORKMANSHIP CORRECTIVE ACTION ---------- CORRECTED WIRING, INSPECTION FAR 2348: S/N 304 FEB 83 DESCRIPTION ---------- FAILED TO COUNT (SEQUENCE) FOUND DEBRIS INTERFERRING ON DISC. CORRECTIVE ACTION ---------- ECN 12585 IMPROVED INSPECTION. FAR 2402: S/N 201/M1 JULY 87 DESCRIPTION ---------- ANGLE OF TRAVEL OUT OF SPEC. DUE TO BLANKET INTERFERENCE. CORRECTIVE ACTION ---------- REFITTED BLANKET, CAUTIONED OPERATOR.

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CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MECHANICAL ARM

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51T40J1565

SHEET: 7

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1RA CRITICALITY — RATIONALE FOR ACCEPTANCE SCREENS: A-FAIL, B-PASS, C-PASS
4020	1	OPTICAL POSITION ENCODER QTY-5 P/N 51140F680-3 AND QTY-1 P/N 511400231-3	MODE: LOSS OF SINGLE BIT OR ERRATIC OUTPUT. CAUSE(S): (1) INTERNAL PARTS FAILURE OF THE AMPLIFIER, SHIFT REGISTER, PHOTOCELL, OR COMPARATOR. (2) FUNGUS GROWTH ON DISC. (3) LOSS OF EEE PARTS.	POSITION ERROR OF ANY MAGNITUDE UP TO AND INCLUDING MSB. IF ERROR IS LARGE ENOUGH. SOFTWARE STOP MAY BE NON-FUNCTIONAL FOR FAILED JOINT. CONTROL ERROR AND AUTO BRAKES. IN AUTO, ARM WILL STOP, 0 RATE COMMANDED. ENCODER CHECK. IN DIRECT AND BACKUP MODES ARM WILL CONTINUE TO DRIVE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE . WORST CASE --- UNEXPECTED MOTION. INCORRECT POSITION DATA. AUTO BRAKES. REDUNDANT PATHS REMAINING --- AUTOBRAKES	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. CREW ACTION --- APPLY BRAKES. USE DIRECT DRIVE. CREW TRAINING --- THE CREW WILL BE TRAINED TO ALWAYS OBSERVE WHETHER THE ARM IS RESPONDING PROPERLY TO COMMANDS. IF IT ISN'T, APPLY BRAKES. 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. SCREEN FAILURES --- A: JOINT ENCODER CANNOT BE DRIVEN THROUGH ITS FULL TRAVEL. OMRSD OFFLINE --- NONE OMRSD ONLINE INSTALLATION --- NONE OMRSD ONLINE TURNAROUND --- NONE

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