

ITEM REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RDM / FUNC. 3/1RAD CRITICALITY	RATIONALE FOR ACCEPTANCE
4640	1	SHOULDER FUSING, 45 PRIME CHANNEL FUSES, 16 BACK-UP CHANNEL FUSES. WIRING SCHEMATIC 51140E316 REVISION C.	MODE: LOSS OF PRIMARY OR BACK UP HEATER FUSE.  CAUSE(S): (1) MECHANICAL SHOCK, VIBRATION, MATERIALS (PRIME FUSES 24 THROUGH 37, B/U FUSES 2 THROUGH 14 AND 16)	ONE OF TWO 20V HEATER WIRES TO A HEATER GROUP WILL BE LOST. NO EFFECT WILL BE NOTICED.  WORST CASE NO EFFECT ON CREW/VEHICLE OR MISSION.  REDUNDANT PARTS REMAINING 1 FUSE FOR FAILED GROUP 2 FUSES FOR ALTERNATE SYSTEM HEATER GROUP	DESIGN FEATURES FUSES USED IN THE SHOULDER FUSE PLUG ASSEMBLIES ARE OF THE DESIGN DEFINED BY NSFC SPECIFICATION 40M38250. FOR SRMS APPLICATION, DESIGN AND PROCESS IMPROVEMENTS HAVE BEEN NEGOTIATED WITH, AND IMPLEMENTED BY, THE MANUFACTURER. THESE INCLUDE: - IMPROVED ATTACHMENT OF END CAPS. - CONTROL OF FUSE ELEMENT LENGTH AND DISPOSITION WITHIN THE FUSE BODY TUBE. - CONTROL SOLDERING BETWEEN FUSE ELEMENT AND THE END CAPS.  PRIOR TO ASSEMBLY IN THE FUSE PLUG ASSEMBLY, A CONNECT PIN IS SOLDERED TO EACH OF THE FUSE LEAD WIRES. THIS PROCESS IS CONTROLLED BY ESTABLISHED PROCEDURES WHICH INCLUDE THE REQUIREMENT OF A "METERED" QUALITY OF SOLDER FOR EACH SOLDER JOINT. THE FUSE BODY AND LEAD WIRES ARE SLEEVED TO PRECLUDE SHORT CIRCUITS. EACH FUSE AND ALL SOLDERED JOINTS ARE SUBJECT TO RADIOGRAPHIC INSPECTION.  THE FUSE PLUG ASSEMBLY INCLUDES AN ALUMINUM POTTING SHEL. FOLLOWING INTEGRATION OF THE FUSES, THE CONNECTOR ASSEMBLY IS POTTED USING A SEMI-RESILIENT (RTV) COMPOUND. THE POTTING MEDIUM PROVIDES GOOD HEAT TRANSFER AND ENSURES MECHANICAL STABILITY OF THE INDIVIDUAL FUSES.  POWER TO THE END EFFECTOR HEATERS IS CONDUCTED BY 2 PARALLEL WIRES, EACH OF WHICH IS PROTECTED BY A 5 AMP FUSE.	

PREPARED BY: MFG

SUPRECEDING DATE: 28 OCT 86

APPROVED BY:

DATE:

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
ASS'Y NOMENCLATURE: SHOULDER

SYSTEM: MECHANICAL ARM SUBSYSTEM  
ASS'Y P/N: 51140J1219

SHEET: 2

P/N REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOW / FORC. 3/TRAB CRITICALITY	RATIONALE FOR ACCEPTANCE
4640	1	SHOULDER FUSING. 45 PRIME CHANNEL FUSES. 16 BACK-UP CHANNEL FUSES. WIRING SCHEMATIC 51140E316 REVISION C.	<p>MODE: LOSS OF PRIMARY OR BACK UP HEATER FUSE.</p> <p>CAUSE(S): (1) MECHANICAL SHOCK, VIBRATION, MATERIALS (PRIME FUSES 24 THROUGH 37, B/U FUSES 2 THROUGH 14 AND 16)</p>	<p>ONE OF TWO 20V HEATER WIRES TO A HEATER GROUP WILL BE LOST. NO EFFECT WILL BE NOTICED.</p> <p>WORST CASE NO EFFECT ON CREW/VEHICLE OR MISSION.</p> <p>REDUNDANT PATHS REMAINING</p> <p>1 FUSE FOR FAILED GROUP 2 FUSES FOR ALTERNATE SYSTEM HEATER GROUP</p>		<p>ACCEPTANCE TESTS</p> <p>THE SHOULDER, ELBOW AND WRIST JOINTS ARE SUBJECTED TO THE FOLLOWING ACCEPTANCE ENVIRONMENTAL TESTING.</p> <p>O VIBRATION: LEVEL AND DURATION - REFERENCE TABLES 9, 10 AND 11.</p> <p>O THERMAL: +70 DEGREES C TO -25 DEGREES C (2 CYCLES) 1 X 10<sup>06</sup> TORR.</p> <p>THE JOINTS ARE INTEGRATED INTO THE RMS SYSTEM (PER 1P532) WHICH IS FURTHER TESTED IN (1P510 RMS STRONGBACK AND 1P552 FLAT FLOOR). THESE TESTS VERIFIES THE ABSENCE OF THE FAILURE MODE.</p> <p>QUALIFICATION TESTS</p> <p>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.</p> <p>O VIBRATION: LEVEL AND DURATION REFERENCE TABLES 9 AND 10</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<sup>06</sup> TORR.</p> <p>O EMC: MIL-STD-461 AS MODIFIED BY SL-E-0002 (TESTS CE01, CE03, CS01, CS02, CS06, RE02 (N/B).</p> <p>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.</p> <p>O LOAD TEST: SHOULDER JOINT STRUCTURAL LOAD TEST REFERENCE TABLE 12.</p> <p>NOTE:</p> <p>ELBOW JOINT (S/M 302 AND UP) INCORPORATES NON-WELDED TRANSITIONS WHICH WAS LOAD TESTED TO LOAD IN REFERENCE TABLE 18S.</p> <p>FLIGHT CHECKOUT</p> <p>PDRS OPS CHECKLIST (ALL VEHICLES) JSC 16907</p>

RMS/MECH - 381

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
ASS'Y NOMENCLATURE: SHOULDER

SYSTEM: MECHANICAL ARM SUBSYSTEM  
ASS'Y P/N: 51140J1219

SHEET: 3

P/N REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RISK / FUNC. 3/IRAD CRITICALITY RATIONALE FOR ACCEPTANCE
4640	1	SHOULDER FUSING. 45 PRIME CHANNEL FUSES. 16 BACK-UP CHANNEL FUSES. WIRING SCHEMATIC 51140E316 REVISION C.	<p>MODE: LOSS OF PRIMARY OR BACK UP HEATER FUSE.</p> <p>CAUSE(S): (1) MECHANICAL SHOCK VIBRATION, MATERIALS (PRIME FUSES 24 THROUGH 37, B/U FUSES 2 THROUGH 14 AND 16)</p>	<p>ONE OF TWO 28V HEATER WIRES TO A HEATER GROUP WILL BE LOST. NO EFFECT WILL BE NOTICED.</p> <p>WORST CASE</p> <p>NO EFFECT ON CREW/VEHICLE OR MISSION.</p> <p>REDUNDANT PATHS REMAINING</p> <p>1 FUSE FOR FAILED GROUP 2 FUSES FOR ALTERNATE SYSTEM HEATER GROUP</p>	<p>QA/INSPECTIONS</p> <p>FUSES ARE PROCURED AS A EEE PART TO SPAR SPECIFICATION SPAR-SG459/023, WHICH INCORPORATES SPECIFICATION NSFC40M30259 AS REQUIRED BY SPAR-RMS-PA.003. QUALIFICATION, ACCEPTANCE TESTING AND RELIABILITY LIFE TESTING OF FUSE PLUG ASSEMBLIES WAS PERFORMED TO THE REQUIREMENTS OF THE SPAR-RMS-TP.952.</p> <p>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, MAXIMUM 5 PIECES, MINIMUM 3 PIECES FOR EACH LOT NUMBER/DATE CODE OF PARTS RECEIVED.</p> <p>WIRE IS PROCURED TO SPECIFICATION MIL-W-22759 OR MIL-W-81381 AND INSPECTED AND TESTED TO NASA JSC80000 STANDARD NUMBER 95A.</p> <p>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.</p> <p>PARTS ARE INSPECTED THROUGHOUT MANUFACTURE AND ASSEMBLY AS APPROPRIATE TO THE MANUFACTURING STAGE COMPLETED. THESE INSPECTIONS INCLUDE,</p> <p>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 00000A.</p> <p>PRIOR TO POTTING, THE SOLDERED CONTACTS OF THE FUSE ASSEMBLY ARE SUBJECT TO RADIOGRAPHIC INSPECTION TO CHECK FOR POROSITY AND INTERNAL FLAWS.</p> <p>PRE AND POST POTTING INSPECTIONS TO SPAR-ITP 257 VERIFY VOLTAGE DROP (RESISTANCE) AT HIGH AND LOW TEMPERATURE (-30 DEGREES C AND +110 DEGREES C) (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT).</p> <p>FUSES ARE ACCEPTANCE TESTED TO SPAR-ITP 257 WHICH INCLUDES AMBIENT TESTING AND THERMAL CYCLING, (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT).</p> <p>PRIOR TO MATING FUSE PLUG WITH RECEPTACLE ON SHOULDER CONNECTOR BOX, INSPECTIONS INCLUDE VISUAL, CLEANLINESS, WORKMANSHIP, IDENTIFICATION, CHECK FOR BENT OR PUSHED BACK CONTACTS ETC.</p> <p>JOIN LEVEL PRE-ACCEPTANCE TEST INSPECTION, INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC.</p>

PREPARED BY: MEWG

SUPERSEDING DATE: 20 OCT 86

APPROVED BY: \_\_\_\_\_

DATE: \_\_\_\_\_

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
ASS'Y NOMENCLATURE: SHOULDER

SYSTEM: MECHANICAL ARM SUBSYSTEM  
ASS'Y P/N: 511401219

SHEET: 4

P/N & REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOM / FUNC. 3/IRAD CRITICALITY	RATIONALE FOR ACCEPTANCE
4640	1	SHOULDER FUSING. 45 PRIME CHANNEL FUSES. 16 BACK-UP CHANNEL FUSES. WIRING SCHEMATIC 51140E316 REVISION C.	MODE: LOSS OF PRIMARY OR BACK UP HEATER FUSE.  CAUSE(S): (1) MECHANICAL SHOCK VIBRATION, MATERIALS (PRIME FUSES 24 THROUGH 37, B/U FUSES 2 THROUGH 14 AND 16)	ONE OF TWO 28V HEATER WIRES TO A HEATER GROUP WILL BE LOST. NO EFFECT WILL BE NOTICED.  WORST CASE ----- NO EFFECT ON CREW/VEHICLE OR MISSION.  REDUNDANT PATHS REMAINING ----- 1 FUSE FOR FAILED GROUP 2 FUSES FOR ALTERNATE SYSTEM HEATER GROUP		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).  JOINT LEVEL 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)

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
 ASS'Y NOMENCLATURE: SHOULDER

SYSTEM: MECHANICAL ARM SUBSYSTEM  
 ASS'Y P/N: 51140J1219

SHEET: 5

FMEA REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	MODE / FUNC. 3/1RAD CRITICALITY	RATIONALE FOR ACCEPTANCE
4640	1	SHOULDER FUSING. 45 PRIME CHANNEL FUSES. 16 BACK-UP CHANNEL FUSES. WIRING SCHEMATIC 51140E316 REVISION C.	<p>MODE: LOSS OF PRIMARY OR BACK UP HEATER FUSE.</p> <p>CAUSE(S): (1) MECHANICAL SHOCK, VIBRATION, MATERIALS (PRIME FUSES 26 THROUGH 37, B/U FUSES 2 THROUGH 14 AND 16)</p>	<p>ONE OF TWO 20V HEATER WIRES TO A HEATER GROUP WILL BE LOST. NO EFFECT WILL BE NOTICED.</p> <p>WORST CASE NO EFFECT ON CREW/VEHICLE OR MISSION.</p> <p>REDUNDANT PATHS REMAINING 1 FUSE FOR FAILED GROUP 2 FUSES FOR ALTERNATE SYSTEM HEATER GROUP</p>	<p>FAILURE HISTORY</p> <p>THE FOLLOWING FAILURE ANALYSIS REPORT(S) ARE RELEVANT:</p> <p>FAR 2114: S/N 202 JUL 80</p> <p>DESCRIPTION HIGH RESISTANCE FOLLOWING THERMAL CYCLING CAUSED BY MFG. DEFECT.</p> <p>CORRECTIVE ACTION MFG TO IMPLEMENT THERMAL TESTING. (FMEA NO. 4590, 4670)</p> <p>FAR 2120: S/N 201 JAN 81</p> <p>DESCRIPTION HIGH RESISTANCE, MFG DEFECT. REFER TO FAR 2114. OUT-PUT DID NOT SWITCH, FOLLOWING HUMIDITY TEST, DUE TO SHORTED LED</p> <p>CORRECTIVE ACTION REFER TO FAR 2114 (FMEA NO.4590, 4670) REPLACED LED.</p> <p>FAR 2358: S/N 302 MAY 83</p> <p>DESCRIPTION FUSE FAILED OPEN, CAUSED BY DAMAGED SOLDER CONN DURING REMORK.</p> <p>CORRECTIVE ACTION SCRAPPED REMORKED FUSES. ECM S1130 MODIFIED TESTING. (FMEA NO. 4590, 4670)</p> <p>FAR 2370: S/N 304 NOV 83</p> <p>DESCRIPTION VOLTAGE DROP EXCESSIVE, CAUSE DESIGN/MANUFACTURING FAULT.</p> <p>CORRECTIVE ACTION SCRAPPED ALL FUSES, PREPARED NEW FUSE SPEC. (FMEA NO. 4590; 4670)</p>	

PREPARED BY: NFMG

SUPERCEDING DATE: 28 OCT 86

APPROVED BY: \_\_\_\_\_

DATE: \_\_\_\_\_

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
ASS'Y NOMENCLATURE: SHOULDER

SYSTEM: MECHANICAL ARM SUBSYSTEM  
ASS'Y P/N: 51140J1210

SHEET: 6

AREA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	MOR / FURC. 3/1RAB CRITICALITY RATIONALE FOR ACCEPTANCE
4440	1	SHOULDER FUSING. 45 PRIME CHANNEL FUSES. 16 BACK-UP CHANNEL FUSES. WIRING SCHEMATIC 51140E316 REVISION C.	MODE: LOSS OF PRIMARY OR BACK UP HEATER FUSE.  CAUSE(S): (1) MECHANICAL SHOCK, VIBRATION, MATERIALS (PRIME FUSES 24 THROUGH 37, B/U FUSES 2 THROUGH 14 AND 16)	ONE OF TWO 28V HEATER WIRES TO A HEATER GROUP WILL BE LOST. NO EFFECT WILL BE NOTICED.  WORST CASE  NO EFFECT ON CREW/VEHICLE OR MISSION.  REDUNDANT PATHS REMAINING  1 FUSE FOR FAILED GROUP 2 FUSES FOR ALTERNATE SYSTEM HEATER GROUP	<p>OPERATIONAL EFFECTS</p> <p>NONE. WITH EACH SUBSEQUENT FAILURE A LEVEL OF REDUNDANCY IS LOST. WITH LOSS OF ALL PATHS ONE JOINT MAY MOVE AT A SLOWER THAN COMMANDED RATE IF A PRIOR FAILURE OF THE HEATER CIRCUIT HAS OCCURRED. ARM DOES NOT RESPOND CORRECTLY TO COMMANDS. CREW WILL INHERENTLY COMPENSATE IN MANUAL AUGMENTED MODE.</p> <p>CREW ACTION</p> <p>APPLY BRAKES</p> <p>CREW TRAINING</p> <p>CREW WILL BE TRAINED TO RECOGNIZE IF THE ARM IS RESPONDING CORRECTLY TO COMMANDS.</p> <p>MISSION CONSTRAINT</p> <p>OPERATE UNDER VERNIER RATES WITHIN 10 FT. OF STRUCTURE. AUTO TRAJECTORIES MUST BE DESIGNED TO COME NO CLOSER THAN 5 FT. FROM STRUCTURE. THE OPERATOR MUST BE ABLE TO DETECT THAT THE ARM IS RESPONDING PROPERLY TO COMMANDS VIA WINDOW AND/OR CCTV VIEWS DURING ALL OPERATIONS. BOTH HEATER POWER BUSES TO BE IN AUTO WHEN OPERATING ARM.</p> <p>SCREEN FAILURES</p> <p>A: INDEPENDENT THERMOSTATS ARE NOT ACCESSIBLE, ARE NOT INSTRUMENTED AND THE REDUNDANT ELEMENTS ARE STILL OPERABLE. B: REDUNDANT ELEMENTS ARE STILL OPERABLE.</p> <p>OMRSD OFFLINE</p> <p>VERIFY INDIVIDUAL FUSES FOR WRIST AND END EFFECTOR WITH ARM SPLIT AT ELBOW.</p> <p>OMRSD ONLINE INSTALLATION</p> <p>NONE</p> <p>OMRSD ONLINE TURNAROUND</p> <p>NONE</p>