

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: THERMAL SYSTEM

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140J1857

SHEET: 1

YMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOLD / FUNC. 3/1RAD CRITICALITY	RATIONALE FOR ACCEPTANCE
4360	0	THERMOSTAT QTY-4 PER ELEMENT SET P/N SG.459/006	<p>MODE: ONE THERMOSTAT FAILS OPEN OR SHORTED IN EITHER THE PRIME OR REDUNDANT.</p> <p>CAUSE(S): (1) OPEN OR SHORT SWITCH CONTACTS.</p>	<p>NONE - THE OTHER THREE THERMOSTATS WILL CONTROL THE HEATERS.</p> <p>WORST CASE ----- NO EFFECT ON CREW/VEHICLE OR MISSION.</p> <p>REDUNDANT PATHS REMAINING ----- ONE THERMOSTAT IN FAILED SYSTEM AND TWO THERMOSTATS IN OTHER SYSTEM.</p>	<p>DESIGN FEATURES -----</p> <p>THE BASIC DESIGN FEATURES, OF THE SRMS HEATERS, ARE IDENTICAL TO THE ORBITER HEATERS DEFINED BY ROCKWELL SPECIFICATIONS MC363-0024, -0031, AND -0037. THE SPECIFIC FEATURES FOR SRMS USE (SHAPE, SIZE, ELEMENT RESISTANCE) ARE DEFINED BY SPAR-SG.459/006.</p> <p>CONNECTION, TO THE HEATER ELEMENT, IS BY MEANS OF A PAIR OF TEFLON-INSULATED WIRES. IN GENERAL, THESE WIRES ARE TERMINATED IN CRIMP-STYLE CONTACTS AND THE CONTACTS ARE INSERTED BY DEUTCH BLOCK CONNECTORS. WHERE NECESSARY TO TERMINATE A WIRE DIRECTLY AT A THERMAL SWITCH, CONNECTIONS ARE MADE BY SOLDER JOINT. ALL SOLDER JOINTS ARE COVERED WITH SOLITHANE TO PRECLUDE SHORT CIRCUITS. ALL WIRE RUNS ARE STRAPPED AT INTERVALS TO ENSURE NO RELATIVE MOTION DUE TO VIBRATION/SHOCK.</p> <p>THE HEATER SYSTEMS ARE DUPLICATED AND OPERABLE IN STANDBY REDUNDANCY.</p>	

PREPARED BY: MFMG

SUPERCEDING DATE: 11 SEP 86

APPROVED BY: _____

DATE: _____

CRITICAL ITEMS LIST

PROJECT: RMS
ASS'Y NOMENCLATURE: THERMAL SYSTEM

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 5114011657

SHEET: 2

ITEM REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOW / FUNC. 3/1RAD CRITICALITY	RATIONALE FOR ACCEPTANCE
4360	0	THERMOSTAT QTY-4 PER ELEMENT SET P/N SG.459/006	<p>MODE: ONE THERMOSTAT FAILS OPEN OR SHORTED IN EITHER THE PRIME OR REDUNDANT.</p> <p>CAUSE(S): (1) OPEN OR SHORT SWITCH CONTACTS.</p>	<p>NONE - THE OTHER THREE THERMOSTATS WILL CONTROL THE HEATERS.</p> <p>WORST CASE NO EFFECT ON CREW/VEHICLE OR MISSION.</p> <p>REDUNDANT PATHS REMAINING</p> <p>ONE THERMOSTAT IN FAILED SYSTEM AND TWO THERMOSTATS IN OTHER SYSTEM.</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**6 TORR.</p> <p>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.</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**6 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/N 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 16987</p>	

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 ASS'Y P/N: 5114031857

SHEET: 3

P/N & REV.	REV.	NAME QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RISK / FUNC. S/IRAD CRITICALITY	RATIONALE FOR ACCEPTANCE
4360	0	THERMOSTAT QTY-4 PER ELEMENT SET P/N SG.459/006	<p>MODE: ONE THERMOSTAT FAILS OPEN OR SHORTED IN EITHER THE PRIME OR REDUNDANT.</p> <p>CAUSE(S): (1) OPEN OR SHORT SWITCH CONTACTS.</p>	<p>NONE - THE OTHER THREE THERMOSTATS WILL CONTROL THE HEATERS.</p> <p>WORST CASE</p> <p>NO EFFECT ON CREW/VEHICLE OR MISSION.</p> <p>REDUNDANT PATHS REMAINING</p> <p>ONE THERMOSTAT IN FAILED SYSTEM AND TWO THERMOSTATS IN OTHER SYSTEM.</p>	QA/INSPECTIONS	<p>THERMOSTATIC SWITCHES ARE PROCURED TO THE REQUIREMENTS OF SPAR SPECIFICATION SG.459/006 FROM SUNDSTRAND DATA CONTROL, AN APPROVED SUPPLIER UNDER LISTING OPL-24236 FOR MIL-S-24236/1, TYPE 1, CLASS 4, CATEGORY 1 SWITCHES. SWITCHES ARE SCREENED AND ACCEPTANCE TESTED BY SUNDSTRAND. ACCEPTANCE TESTING OF SWITCHES CONSIST OF THE FOLLOWING TESTS, RANDOM VIBRATION, PIND, CALIBRATION, CREEPAGE, SEAL, DIELECTRIC WITHSTANDING VOLTAGE, INSULATION RESISTANCE, CONTACT RESISTANCE AND INSPECTION OF PRODUCT. ADDITIONALLY UPON RECEIPT AT SPAR, SWITCHES ARE SUBJECT TO RADIOGRAPHIC INSPECTION BY A SPAR APPROVED FACILITY IN ACCORDANCE WITH THE REQUIREMENTS OF NSFC-STD-355.</p> <p>WIRE IS PROCURED TO SPECIFICATION MIL-W-22759 OR MIL-W-81381 AND INSPECTED AND TESTED TO NASA JSCM0000 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 0800A.</p> <p>AFTER INSTALLATION, HEATERS AND THERMAL SWITCHES ARE VERIFIED AND TESTED TO THE REQUIREMENTS OF THE APPLICABLE JOINT/END EFFECTOR INSPECTION TEST PROCEDURE (ITP) WHICH INCLUDES RESISTANCE MEASUREMENTS OF EACH HEATER CIRCUIT, PRIME AND BACKUP.</p> <p>PRE-ACCEPTANCE TEST INSPECTION, WHICH INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC., (MANDATORY INSPECTION POINT).</p> <p>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).</p> <p>ACCEPTANCE TESTING (ATP) INCLUDES, AMBIENT, VIBRATION AND THERMAL-VAC TESTING, (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT)</p> <p>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</p>

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SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 511401187

SHEET: 4

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDMN / FOWC. S/IRAB CRITICALITY	RATIONALE FOR ACCEPTANCE
4360	0	THERMOSTAT QTY-4 PER ELEMENT SET P/N SG.459/006	<p>MODE: ONE THERMOSTAT FAILS OPEN OR SHORTED IN EITHER THE PRIME OR REDUNDANT.</p> <p>CAUSE(S): (1) OPEN OR SHORT SWITCH CONTACTS.</p>	<p>NONE - THE OTHER THREE THERMOSTATS WILL CONTROL THE HEATERS.</p> <p>WORST CASE ----- NO EFFECT ON CREW/VEHICLE OR MISSION.</p> <p>REDUNDANT PATHS REMAINING ----- ONE THERMOSTAT IN FAILED SYSTEM AND TWO THERMOSTATS IN OTHER SYSTEM.</p>		<p>INCLUDES GROUNDING CHECKS, THRU WIRING CHECKS, WIRING ROUTING, INTERFACE CONNECTORS FOR BENT OR PUSH BACK CONTACTS ETC.</p> <p>SRMS SYSTEMS TESTING - STRONGBACK AND FLAT FLOOR AMBIENT PERFORMANCE TEST. (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT)</p>

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SHEET: 5

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOW / FUNC. 3/TRAB CRITICALITY RATIONALE FOR ACCEPTANCE
4360	0	THERMOSTAT QTY-4 PER ELEMENT SET P/N SG.459/006	MODE: ONE THERMOSTAT FAILS OPEN OR SHORTED IN EITHER THE PRIME OR REDUNDANT. CAUSE(S): (1) OPEN OR SHORT SWITCH CONTACTS.	NONE - THE OTHER THREE THERMOSTATS WILL CONTROL THE HEATERS. WORST CASE NO EFFECT ON CREW/VEHICLE OR MISSION. REDUNDANT PATHS REMAINING ONE THERMOSTAT IN FAILED SYSTEM AND TWO THERMOSTATS IN OTHER SYSTEM.	FAILURE HISTORY ----- THERE HAVE BEEN NO FAILURES ASSOCIATED WITH THIS FAILURE MODE ON THE SRMS PROGRAM.

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SHEET: 6

P/N REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HORN / FUNC. 3/IRAB CRITICALITY	RATIONALE FOR ACCEPTANCE
4360	0	THERMOSTAT QTY-4 PER ELEMENT SET P/N SG.459/006	MODE: ONE THERMOSTAT FAILS OPEN OR SHORTED IN EITHER THE PRIME OR REDUNDANT. CAUSE(S): (1) OPEN OR SHORT SWITCH CONTACTS.	NONE - THE OTHER THREE THERMOSTATS WILL CONTROL THE HEATERS. WORST CASE ----- NO EFFECT ON CREW/VEHICLE OR MISSION. REDUNDANT PATHS REMAINING ----- ONE THERMOSTAT IN FAILED SYSTEM AND TWO THERMOSTATS IN OTHER SYSTEM.	OPERATIONAL EFFECTS ----- NONE. 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. CREW ACTION ----- APPLY BRAKES CREW TRAINING ----- CREW WILL BE TRAINED TO RECOGNIZE IF THE ARM IS RESPONDING CORRECTLY TO COMMANDS. MISSION CONSTRAINT ----- 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 ARM OPERATIONS. BOTH HEATER POWER BUSES TO BE IN AUTO WHEN OPERATING ARM. SCREEN FAILURES ----- A: INDEPENDENT THERMOSTATS ARE NOT ACCESSIBLE ARE NOT INSTRUMENTED AND THE REDUNDANT ELEMENTS ARE STILL OPERABLE. B: REDUNDANT ELEMENTS ARE STILL OPERABLE. OMRSD OFFLINE ----- NONE OMRSD ONLINE INSTALLATION ----- NONE OMRSD ONLINE TURNAROUND ----- NONE	

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