

**Critical Items List**

PROJECT: SRMS  
ASS'Y NOMENCLATURE: END EFFECTOR

SYSTEM: MECHANICAL ARM SUBSYSTEM  
ASS'Y P/N: 5114061470 SHEET: 1

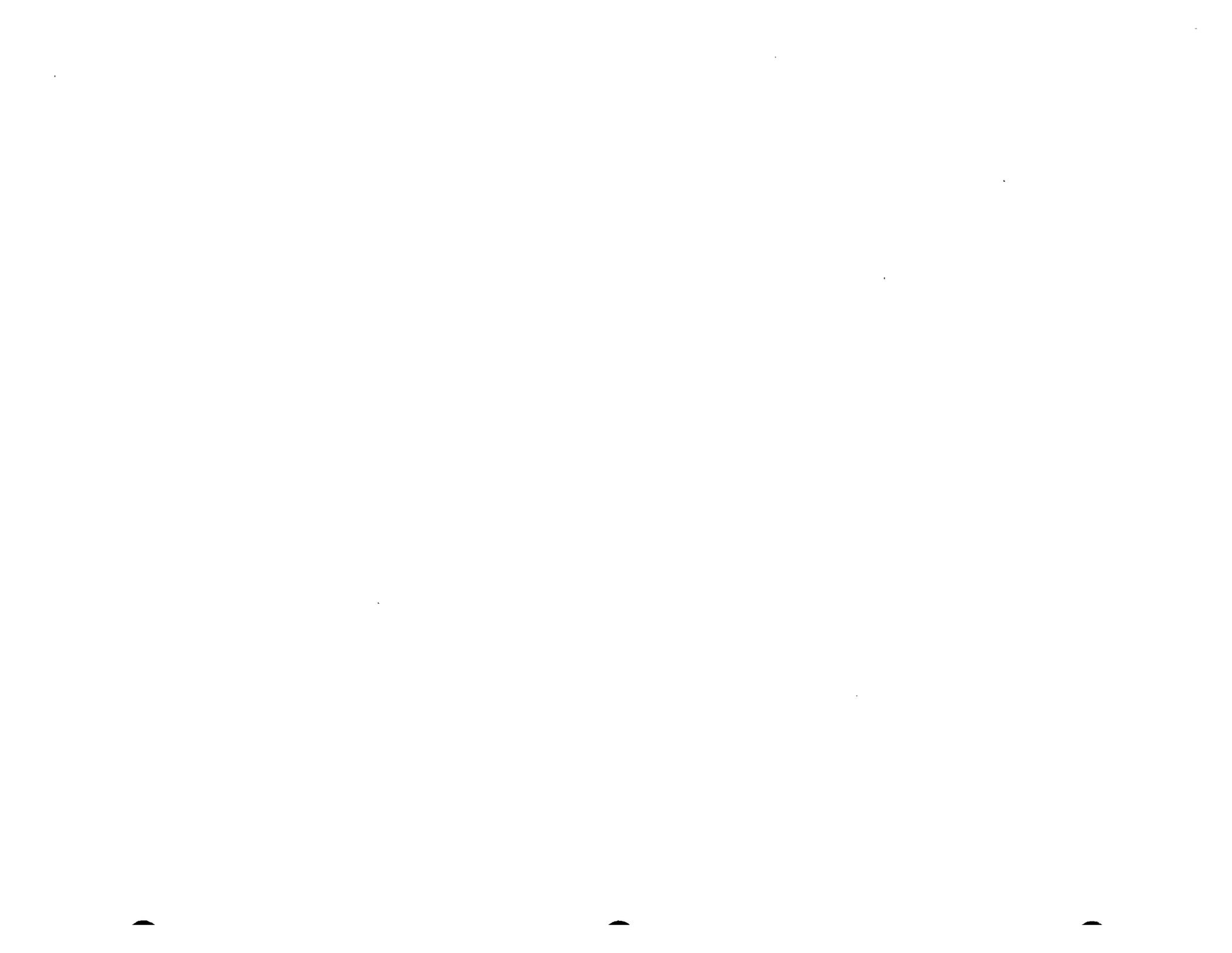
ITEM REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOUR / FUNC. % CRITICALITY	RATIONALE FOR ACCEPTANCE
3760	0	E/E SHARE CABLE QTY-1 P/N 5114061612	<p>MODE: ONE OR MORE CABLES RELEASED.</p> <p>CAUSE(S): (1) FRACTURE OF CABLES OR FITTINGS.</p>	<p>UNABLE TO CAPTURE OR RIGIDIZE PAYLOAD. IF A PAYLOAD HAS BEEN CAPTURED IT WILL BE RELEASED.</p> <p>WORST CASE</p> <p>UNCOMMANDED RELEASE. CREW ACTION REQUIRED.</p> <p>REDUNDANT PATHS REMAINING</p> <p>N/A</p>		<p>DESIGN FEATURES</p> <p>MATERIALS SELECTION AND USAGE CONFORMS TO SPAR-SG.368 WHICH IS EQUIVALENT TO THE NASA MATERIALS USAGE REQUIREMENTS.</p> <p>THE STRUCTURAL ANALYSIS CONDUCTED ON THE END EFFECTOR, PER SPAR-IM.1531, CONFIRMED A POSITIVE MARGIN OF SAFETY FOR ALL END EFFECTOR PARTS AND GEARS. THE MARGIN OF SAFETY FOR ULTIMATE STRENGTH M(UTS) INCORPORATES A FACTOR OF SAFETY OF 1.4 AGAINST LIMIT LOAD, AS SPECIFIED IN SPAR-SG. 392.</p> <p>A NEGATIVE MARGIN DOES NOT NECESSARILY IMPLY BREAKAGE OF THE PART, RATHER IT INDICATES THAT A LIMITING STRESS LEVEL, ESTABLISHED BY THE FACTOR OF SAFETY, HAS BEEN EXCEEDED.</p> <p>THE MARGIN OF SAFETY FOR YIELD STRENGTH S(YIELD) EMPLOYS A FACTOR OF SAFETY OF 1.0 AGAINST LIMIT LOAD, AS SPECIFIED IN SPAR-SG.392. TABLE 14 LISTS MARGINS OF SAFETY FOR SRMS STRUCTURAL COMPONENTS.</p> <p>A FATIGUE ANALYSIS WHICH SHOWS INDEFINITE LIFE HAS BEEN PERFORMED ON THE GEARS AND MECHANICAL FASTENERS AND A FRACTURE ANALYSIS WHICH SHOWS LIVES GREATER THAN 424 MISSIONS HAS BEEN DEMONSTRATED ON STRUCTURAL COMPONENTS WITHIN THE END EFFECTOR.</p> <p>THE END EFFECTOR SHARE CABLES WERE SUBJECTED TO A RIGOROUS DEVELOPMENT PROGRAM, IN ACCORDANCE WITH SPAR-TP.052 AND SPAR-TP.055, TO IDENTIFY BREAKING STRENGTH, FATIGUE LIFE, LOAD DECAY VERSES TIME AND WEAR PARAMETERS. THE RESULTS OF THESE DEVELOPMENT TESTS, AFTER THE APPLICATION OF 2120 CYCLES, ARE RECORDED IN SPAR-1.192.</p> <p>EACH INDIVIDUAL SHARE CABLE IS PROOF LOADED TO 1600 LBS. PRIOR TO ACCEPTANCE FOR USE IN END EFFECTORS. THIS VALUE IS SLIGHTLY GREATER THAN THE MAXIMUM LOAD CASE OF 1558 LBS. EXPECTED AT THE MAXIMUM SPECIFIED BENDING MOMENT LOAD OF 1200 FT-LBS AND REPRESENTS 66% OF THE CABLE BREAKING FORCE OF 2400 LBS.</p>

PREPARED BY: MFMG

SUPERCEDING DATE: 11 SEP 86

APPROVED BY:

DATE:



**CRITICAL ITEMS LIST**

PROJECT: SRMS  
 ASS'Y NOMENCLATURE: END EFFECTOR

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

SHEET: 2

P/N & REF.	REV.	NAME QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOW / FUNC. I/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
3760	0	E/E SWARE CABLE QTY-1 P/N 51140D1612	MODE: ONE OR MORE CABLES RELEASED.  CAUSE(S): (1) FRACTURE OF CABLES OR FITTINGS.	UNABLE TO CAPTURE OR RIGIDIZE PAYLOAD. IF A PAYLOAD HAS BEEN CAPTURED IT WILL BE RELEASED.  WORST CASE UNCOMMANDED RELEASE. CREW ACTION REQUIRED.  REDUNDANT PATHS REMAINING  N/A		ACCEPTANCE TESTS ----- THE EE ASSEMBLY IS TESTED TO THE FOLLOWING ACCEPTANCE ENVIRONMENTS:  O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 7  O THERMAL VACUUM: +70 DEGREES C TO -25 DEGREES C (1 1/2 CYCLES) 1 X 10 <sup>-6</sup> TORR  THE EE ASSEMBLY IS FURTHER TESTED IN THE IN THE RMS SYSTEM TEST (TP51B RMS STRONGBACK AND TP52Z FLAT FLOOR TESTS) WHICH VERIFIES THE ABSENCE OF THE FAILURE MODE.  QUALIFICATION TESTS ----- THE EE ASSEMBLY QUALIFICATION TESTING CONSISTED OF THE FOLLOWING ENVIRONMENTS:  O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 7  O SHOCK: 20G/11 MS - 3 AXES (6 DIRECTIONS)  O THERMAL VACUUM: +81 DEGREES C TO -36 DEGREES C (6 CYCLES) 1 X 10 <sup>-6</sup> TORR  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.  O EMC: MIL-STD-461A AS MODIFIED BY SL-E-0002 (TEST CE01, CE03, CS01, CS02, CS06, RE02 (N/B))  O STRUCTURAL STIFFNESS AND LOAD TEST  FLIGHT CHECKOUT ----- PDRS OPS CHECKLIST (ALL VEHICLES) JSC 16987

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PROJECT: SRMS  
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SYSTEM: MECHANICAL ARM SUBSYSTEM  
 ASS'Y P/N: 51140E1470 SHEET: 3

P/N & REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOW / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
3760	0	E/E SNARE CABLE QTY-1 P/N 51140D1612	MODE: ONE OR MORE CABLES RELEASED.  CAUSE(S): (1) FRACTURE OF CABLES OR FITTINGS.	UNABLE TO CAPTURE OR RIGIDIZE PAYLOAD. IF A PAYLOAD HAS BEEN CAPTURED IT WILL BE RELEASED.  WORST CASE UNCOMMANDED RELEASE. CREW ACTION REQUIRED.  REDUNDANT PATHS REMAINING N/A	QA/INSPECTIONS	<p>SNARE CABLES ARE MANUFACTURED TO SPAR DRAWINGS AND SPECIFICATIONS BY A SPAR APPROVED SUPPLIER. INSPECTIONS ARE PERFORMED TO VERIFY THAT EACH MANUFACTURING, ASSEMBLY AND TEST OPERATION IS SATISFACTORILY COMPLETED. SPAR/GOVERNMENT SOURCE INSPECTION IS INVOKED ON THE PROCUREMENT OF ALL SNARE CABLES.</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>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 INVOKED ON ALL BEARING PROCUREMENTS.</p> <p>SNARE CABLES ARE SUBJECTED TO INSPECTION WITNESS PROOF LOAD TESTING TOGETHER WITH A PRE/POT TEST DIMENSIONAL INSPECTION OF THE CABLE AND SWAGED ENDS.</p> <p>PRIOR INTEGRATION OF SNARE CABLES TO END EFFECTOR ASSY. CABLE ARE INSPECTED TO DRAWING REQUIREMENTS TO VERIFY CABLES LENGTHS, ANGLE POSITION OF SWAGED END, WORKMANSHIP, CLEANLINESS ETC.</p> <p>AFTER INTEGRATION OF CABLES TO END EFFECTOR ASSEMBLY THEY ARE SUBJECTED TO OPERATIONAL TESTING IN ACCORDANCE WITH SPAR-1M1457 TO VERIFY CABLE OPERATION.</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</p>

PREPARED BY: MEWG

SUPERSEDING DATE: 11 SEP 86

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

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
 ASS'Y NOMENCLATURE: END EFFECTOR

SYSTEM: MECHANICAL ARM SUBSYSTEM  
 ASS'Y P/N: 5114001470 SHEET: 4

P/N REF.	REV.	NAME QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RMR / FUNC. I/I CRITICALITY	RATIONALE FOR ACCEPTANCE
3760	0	E/E SNARE CABLE QTY-1 P/N 5114001612	MODE: ONE OR MORE CABLES RELEASED.  CAUSE(S): (1) FRACTURE OF CABLES OR FITTINGS.	UNABLE TO CAPTURE OR RIGIDIZE PAYLOAD. IF A PAYLOAD HAS BEEN CAPTURED IT WILL BE RELEASED.  WORST CASE ----- UNCOMMANDED RELEASE. CREW ACTION REQUIRED.  REDUNDANT PATHS REMAINING ----- N/A		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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SYSTEM: MECHANICAL ARM SUBSYSTEM  
 ASS'Y P/N: 51140E1670 SHEET: 5

P/N & REF.	REV.	NAME QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOW / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
3760	0	E/E SHARE CABLE QTY-1 P/N 51140D1612	MODE: ONE OR MORE CABLES RELEASED.  CAUSE(S): (1) FRACTURE OF CABLES OR FITTINGS.	UNABLE TO CAPTURE OR RIGIDIZE PAYLOAD. IF A PAYLOAD HAS BEEN CAPTURED IT WILL BE RELEASED.  WORST CASE UNCOMMANDED RELEASE. CREW ACTION REQUIRED.  REDUNDANT PATHS REMAINING ----- N/A	FAILURE HISTORY	----- THERE HAVE BEEN NO FAILURES ASSOCIATED WITH THIS FAILURE MODE ON THE SRMS PROGRAM.

PREPARED BY: HWG

SUPERSEDING DATE: 11 SEP 86

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

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PROJECT: SRMS  
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SYSTEM: MECHANICAL ARM SUBSYSTEM  
 ASS'Y P/N: 51140E1470

SHEET: 6

FREA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDRR / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
3760	0	E/E SHARE CABLE QTY-1 P/N 51140D1612	MODE: ONE OR MORE CABLES RELEASED.  CAUSE(S): (1) FRACTURE OF CABLES OR FITTINGS.	UNABLE TO CAPTURE OR RIGIDIZE PAYLOAD. IF A PAYLOAD HAS BEEN CAPTURED IT WILL BE RELEASED.  WORST CASE ----- UNCOMMANDED RELEASE. CREW ACTION REQUIRED.  REDUNDANT PATHS REMAINING ----- N/A	OPERATIONAL EFFECTS -----  CREW ACTION -----  CREW TRAINING -----  MISSION CONSTRAINT -----  SCREEN FAILURES -----  N/A  OMRSD OFFLINE -----  OMRSD ONLINE INSTALLATION -----  NONE  OMRSD ONLINE TURNAROUND -----  PERFORM MANUAL RIGIDIZATION WITH GRAPPLE FIXTURE PRESENT. VERIFY LOAD ON GRAPPLE FIXTURE. INSPECT TO ENSURE NO MORE THAN 10 BROKEN STRANDS PER CABLE.	PAYLOAD WILL BE RELEASED WITH NO OPERATOR COMMAND. IF THIS OCCURS WHILE THE ARM IS BEING DRIVEN, THE PAYLOAD WILL TAKE AN UNEXPECTED TRAJECTORY. DURING CAPTURE SEQUENCE ARM REMAINS LIMP UNTIL EE MODE SWITCH SET TO OFF.  THE CREW WILL BE TRAINED TO MANEUVER THE ORBITER AWAY FROM A FREE FLYING PAYLOAD AT ANY TIME DURING ARM OPERATIONS.  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. EE MODE SWITCH SET TO OFF POSITION IMMEDIATELY AFTER SPEC DRIVE TIME HAS ELAPSED. WHEN CAPTURING A FREE FLYING PAYLOAD, THE EE MUST BE FAR ENOUGH AWAY FROM STRUCTURE TO PROHIBIT CONTACT REGARDLESS OF PAYLOAD ROTATIONS.