

CRITICAL ITEMS LIST

PROJECT: SRMS
 ASS'Y NOMENCLATURE: MOTOR MODULE

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140C1214 SHEET: 1

ITEM REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOUR / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
4080	0	MOTOR SHAFT 51140D12B1 AND QUILL COUPLER QTY-8 51140C1291	MODE: MOTOR SHAFT OR QUILL COUPLER BREAKS. CAUSE(S): (1) FATIGUE FAILURE.	LOSS OF ABILITY TO DRIVE JOINT. MECHANICAL BRAKES ARE EFFECTIVE. ARM MAY TAKE AN UNEXPECTED TRAJECTORY. CONSISTENCY (TACH DATA) CHECK WILL INITIATE AUTO BRAKES. LOSS OF ALL NODES. WORST CASE ----- UNEXPECTED MOTION. FREE JOINT UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING ----- N/A	DESIGN FEATURES ----- THE MINIMUM MARGIN OF SAFETY OF THE DRIVE SHAFT IS 7.44, WHICH INCLUDES ALL STRESS CONCENTRATION FACTORS AND THE LIMIT TO ULTIMATE FACTOR OF 1.4. A FATIGUE ANALYSIS OF THE DRIVE SHAFT SHOWS THAT IT HAS INFINITE LIFE WHEN SUBJECTED TO THE MAXIMUM LOAD CONDITIONS. (THE MARGIN OF SAFETY ON THE ENDURANCE LIMIT IS 2.3). THE ABOVE FACTORS INDICATE THAT STRUCTURAL FAILURE OF THIS ITEM WILL NOT OCCUR. (REF RMS/STR/314). THE MINIMUM MARGIN OF SAFETY OF THIS QUILL IS 26.09 WHICH INCLUDES ALL STRESS CONCENTRATION FACTORS AND THE LIMIT TO ULTIMATE FACTOR OF 1.40. A FATIGUE ANALYSIS OF THE QUILL SHOWS THAT IT HAS INFINITE LIFE WHEN SUBJECTED TO THE MAXIMUM LOAD CONDITIONS. (THE MARGIN OF SAFETY ON THE ENDURANCE LIMIT IS 13.4). THE ABOVE FACTORS INDICATE THAT THE STRUCTURAL FAILURE OF THIS ITEM WILL NOT OCCUR. (REF RMS/STR/314).	

PREPARED BY: MFMG

SUPERCEDING DATE: 11 SEP 86

APPROVED BY:

DATE: _____

CRITICAL ITEMS LIST

PROJECT: SRMS

ASS'Y NOMENCLATURE: MOTOR MODULE

SYSTEM: MECHANICAL ARM SUBSYSTEM

ASS'Y P/N: 51140C1214

SHEET: 2

P/N & REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RDUN / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
4080	0	MOTOR SHAFT 51140D1281 AND QUILL COUPLER QTY-6 51140C1291	MODE: MOTOR SHAFT OR QUILL COUPLER BREAKS. CAUSE(S): (1) FATIGUE FAILURE.	LOSS OF ABILITY TO DRIVE JOINT. MECHANICAL BRAKES ARE EFFECTIVE. ARM MAY TAKE AN UNEXPECTED TRAJECTORY. CONSISTENCY (TACH DATA) CHECK WILL INITIATE AUTO BRAKES. LOSS OF ALL NODES. WORST CASE ----- UNEXPECTED MOTION. FREE JOINT UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING ----- N/A		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 B 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 B 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 ENC: MIL-STD-461 AS MODIFIED BY SL-E-0002 (TESTS CS01, CS02, CS06, CE01, RE02(M/B), RS03, RS04) FLIGHT CHECKOUT ----- PDRS OPS CHECKLIST (ALL VEHICLES) JSC 16987

CRITICAL ITEMS LIST

PROJECT: SRMS
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SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E1214 SHEET: 3

P/N REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOUR / TONC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
4080	0	MOTOR SHAFT 51140D1201 AND QUILL COUPLER QTY-6 51140C1201	MODE: MOTOR SHAFT OR QUILL COUPLER BREAKS. CAUSE(S): (1) FATIGUE FAILURE.	LOSS OF ABILITY TO DRIVE JOINT. MECHANICAL BRAKES ARE EFFECTIVE. ARM MAY TAKE AN UNEXPECTED TRAJECTORY. CONSISTENCY (YACH DATA) CHECK WILL INITIATE AUTO BRAKES. LOSS OF ALL NODES. WORST CASE ----- UNEXPECTED MOTION. FREE JOINT UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING ----- N/A	QA/INSPECTIONS ----- 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, CARPENTER 455 STEEL USED FOR THE MANUFACTURE OF (E.G. GEARS) RECEIVES ADDITIONAL LABORATORY INSPECTIONS WHICH INCLUDE CHEMICAL ANALYSIS, INCLUSION RATING, HARDNESS AND TENSILE TESTING TO VERIFY THE PROPERTIES OF THE MATERIAL SUPPLIED. SHAFTS ARE DIMENSIONAL INSPECTED TO DRAWING REQUIREMENTS THROUGHOUT THE MANUFACTURING STAGES. FOLLOWING HEAT TREATMENT THE SHAFTS ARE SUBJECTED TO MAGNETIC PARTICLE INSPECTION FOR CRACKS. GEAR INSPECTION, BEFORE GEAR LUBRICATION AND RUN-IN A COMPOSITE ERROR GEAR CHECKER IS USED TO VERIFY THAT INVOLUTE FORM, PITCH CIRCLE CONCENTRICITY AND PITCH DIAMETER ARE TO DRAWING REQUIREMENTS. THIS INSPECTION ALSO INCLUDES TEXTURE EVALUATION. AFTER LUBRICATION, GEARS ARE VISUALLY INSPECTED TO CONFIRM APPROPRIATE LUBRICANT APPLICATION AND GEARS ARE THEN RUN-IN, CLEANED AND VISUALLY INSPECTED. FOLLOWING HEAT TREATMENT, STEEL PARTS (E.G. GEARS) ARE SUBJECTED TO A MAGNETIC PARTICLE INSPECTION FOR CRACKS OR IN THE CASE OF ALUMINUM PARTS (E.G. HOUSINGS) ARE DYE PENETRANT INSPECTED USING GROUP V PENETRANTS. WELDING OF GEARS OR HOUSINGS IS SUBJECTED TO DYE PENETRANT (GROUP V) AND RADIOGRAPHIC INSPECTION ON COMPLETION OF STRESS RELIEF TO CHECK FOR CRACKS. QUALIFICATION WELDING TEST SAMPLES FOR STRUCTURAL WELDS ARE SUBJECTED TO DESTRUCTIVE TESTING WHERE POSSIBLE (TENSILE AND BENDING) AS WELL AS METALLAGRAPHIC ANALYSIS TO ENSURE DEFECT FREE WELDS. INSPECTION VERIFIES THAT KITTED PARTS ARE CORRECT PRIOR TO ASSEMBLY AND TRACEABILITY INFORMATION RECORDED. 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, 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	

PREPARED BY: MFNG

SUPERCEDING DATE: 11 SEP 06

APPROVED BY: _____

DATE: _____

CRITICAL ITEMS LIST

PROJECT: SRMS
 ASS'Y NOMENCLATURE: HOYON MODULE

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E1214 SHEET: 4

PMA REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOUR / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
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PROJECT: SRMS
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SYSTEM: MECHANICAL ARM SUBSYSTEM
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PREPARED BY: MFNG SUPERCEDING DATE: 11 SEP 86 APPROVED BY

E: _____

CRITICAL ITEMS LIST

PROJECT: SMS
 ASS'Y NOMENCLATURE: ROTOR MODULE

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 5114001291

SHEET 6

PKA REF.	REV.	NAME QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOWR / FUNC. I/I CRITICALITY	RATIONALE FOR ACCEPTANCE
4000	1	MOTOR SHAFT 5114001201 AND QUILL COUPLER QTY-8 5114001291	MODE: MOTOR SHAFT OR QUILL COUPLER BREAKS. CAUSE(S): (1) FATIGUE FAILURE.	LOSS OF ABILITY TO DRIVE JOINT. MECHANICAL BRAKES ARE EFFECTIVE. ARM MAY TAKE AN UNEXPECTED TRAJECTORY. CONSISTENCY (TACH DATA) CHECK WILL INITIATE AUTO BRAKES. LOSS OF ALL MODES. WORST CASE ----- UNEXPECTED MOTION. FREE JOINT UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING ----- N/A		<p>OPERATIONAL EFFECTS</p> <p>-----</p> <p>ONE JOINT FAILS FREE. THE FAILED JOINT IS ONLY RESTRAINED BY GEARBOX FRICTION. ARM MAY BACKDRIVE IF BRAKES ARE OFF AND ANY OF THE OTHER JOINTS ARE DRIVEN. ARM DOES NOT RESPOND TO COMMANDS. FOR HAND CONTROLLER COMMANDS CREW INHERENTLY COMPENSATES FOR ANY UNDESIRED ARM TRAJECTORY. NO DRIVE MODES AVAILABLE FOR FAILED JOINT.</p> <p>CREW ACTION</p> <p>-----</p> <p>USE SINGLE MODE TO POSITION OTHER JOINTS FOR STOP OR JETTISON</p> <p>CREW TRAINING</p> <p>-----</p> <p>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</p> <p>-----</p> <p>CREW SHOULD BE TRAINED TO 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. ARM SHOULD NOT BE MANEUVERED TO POSITION WHERE JETTISON CANNOT BE SAFELY PERFORMED.</p> <p>SCREEN FAILURES</p> <p>-----</p> <p>N/A</p> <p>OWSD OFFLINE</p> <p>-----</p> <p>IN DIRECT DRIVE WITH ELBOW DENATED VERIFY JOINT MOTION</p> <p>OWSD ONLINE INSTALLATION</p> <p>-----</p> <p>NONE</p> <p>OWSD ONLINE TURNAROUND</p> <p>-----</p> <p>IN SINGLE MODE DRIVE ALL JOINTS VERIFY TACHOMETER SIGNATURE</p>

PREPARED BY: HWG

SUPERSEDING DATE: 26 OCT 87

APPROVED BY: _____