CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MOTOR MODULE
SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1214
SHEET: 1

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	MDUR / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
4070	D	MOTOR MODULE BEARINGS QTY-6 51140D1212-1 D2094-3 D2095-3 D1924-1	MODE: DEGRADED TORQUE OUTPUT FROM MOTOR DRIVE. CAUSE(S): (1) HIGH BEARING FRICTION. (2) LUBRICATION BREAKDOWN OR FAILURE OF SEAL (D1924) (3) LOSS OF BEARING PRELOAD.	DEGRADED OR NO MOTION OF JOINT (SLUGGISH OR FROZEN). ARM MAY TAKE AN UNEXPECTED TRAJECTORY. SPA MAY COMPENSATE WITH HIGHER CURRENT TO MOTOR. MAY LOSE ALL MODES. WORST CASE --------- UNEXPECTED MOTION. FROZEN JOINT. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING --------- N/A		DESIGN FEATURES --------- THE BEARINGS ARE PROCURED BY SPAR AND MEET, OR EXCEED THE REQUIREMENTS OF SPECIFICATION SPAR-SG.393. THE BEARING ANALYSIS USES ULTIMATE LOADS TO DETERMINE THE MARGINS OF SAFETY OF THE LUBRICANT. THE FACTOR BETWEEN WORKING LOADS AND ULTIMATE IS 1.4. THE LUBRICANT FAILURE STRESSES ARE LOWER THAN THE BRINELLING STRESS. LIFE FOR ALL BEARINGS IS GREATER THAN 400 MISSIONS BASED UPON THE ABOVE CRITERIA. THE ALLOWABLE CONTACT STRESS FOR THE LUBRICANT IS ABOUT 1/5TH THE ALLOWABLE CONTACT STRESS FOR THE BEARING, THEREFORE THE LUBRICANT PROPERTIES DICTATE THE DESIGN. THE BEARINGS AS A RESULT ARE LIGHTLY LOADED AND SURFACE FATIGUE IN THE BEARING MATERIAL IS NOT A VIABLE FAILURE MODE. BEARINGS ARE LOCATED IN NON-DEBRIS PRODUCING AREA OF ASSEMBLY. THE SOLID FILM LUBRICANT SYSTEM USED IS LUBECO 905. THIS COMPRISES A SPRAY AND CURE (400 DEGREES F) APPLICATION OF MOLYDENUM DISULPHIDE, IN AN IN ORGANIC BINDER APPLIED PER PPS:28:11 AND 28:13. BURNISHING AND RUN IN PER SPAR PPS 28:14. THE LUBRICATED BEARING IS TORQUE TRACED TO ENSURE ACCEPTABILITY PER SPAR PPS.28:14. THE GREASE LUBRICANT USED IS BRAYCOTE 601 (FORMERLY 3L-38RP) WHICH HAS A PERFLUORINATED POLYETHER OIL BASE WHICH IS VERY STABLE UNDER VACUUM ENVIRONMENT. THE GREASE IS APPLIED IN PRECISE QUANTITY TO EACH BEARING. THE LIFE OF THE BEARING LUBRICATION HAS BEEN ANALYZED USING ULTIMATE LOADS TO EVALUATE HERTZIAN STRESSES. ULTIMATE LOAD = 1.4 X WORKING LOAD. THE LUBRICANT ON ALL BEARINGS IS GOOD FOR OVER 400 MISSIONS USING THE ULTIMATE LOADS. THE MOTOR BEARING PRELOAD IS PROVIDED BY A SILOCON RUBBER 'O' RING HELD IN COMPRESSION. SILICONE RUBBER IS VERY STABLE TO 500 DEGREES F AND VACUUM ENVIRONMENT; IS RESISTANT TO OXIDATION AND OZONE; CAN WITHSTAND HIGH HUMIDITY AND SALT FOG WITHOUT DEGRADATION.

PREPARED BY: MFMG
SUPERCEDING DATE: 11 SEP 86
APPROVED BY:

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MOTOR MODULE
SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1214
SHEET: 2

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDW / FUNC. 1/1 CRITICALITY RATIONALE FOR ACCEPTANCE
4070	0	MOTOR MODULE BEARINGS QTY-6 51140D1212-1 D2094-3 D2095-3 D1924-1	MODE: DEGRADED TORQUE OUTPUT FROM MOTOR DRIVE. CAUSE(S): (1) HIGH BEARING FRICTION. (2) LUBRICATION BREAKDOWN OR FAILURE OF SEAL (D1924) (3) LOSS OF BEARING PRELOAD.	DEGRADED OR NO MOTION OF JOINT (SLUGGISH OR FROZEN). ARM MAY TAKE AN UNEXPECTED TRAJECTORY. SPA MAY COMPENSATE WITH HIGHER CURRENT TO MOTOR. MAY LOSE ALL MODES. WORST CASE --------- UNEXPECTED MOTION. FROZEN 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 8 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 8 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 EMC: MIL-STD-461 AS MODIFIED BY SL-E-0002 (TESTS CS01, CS02, CS06, CE01, RE02(N/B), RS03, RS04) FLIGHT CHECKOUT --------------- PDRS OPS CHECKLIST (ALL VEHICLES) JSC 16987

PREPARED BY: MFWG 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: 51T40E1214
SHEET: 3

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOUR / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
4070	0	MOTOR MODULE BEARINGS QTY-6 51140D1212-1 D2094-3 D2095-3 D1924-1	MODE: DEGRADED TORQUE OUTPUT FROM MOTOR DRIVE. CAUSE(S): (1) HIGH BEARING FRICTION. (2) LUBRICATION BREAKDOWN OR FAILURE OF SEAL (D1924) (3) LOSS OF BEARING PRELOAD.	DEGRADED OR NO MOTION OF JOINT (SLUGGISH OR FROZEN). ARM MAY TAKE AN UNEXPECTED TRAJECTORY. SPA MAY COMPENSATE WITH HIGHER CURRENT TO MOTOR. MAY LOSE ALL MODES. WORST CASE ---------- UNEXPECTED MOTION. FROZEN JOINT. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING ---------- N/A		QA/INSPECTIONS ---------- BEARINGS ARE PROCURED IN ACCORDANCE WITH THE REQUIREMENTS OF SPAR SPECIFICATION SG.393, TO THE APPLICABLE SPAR BEARING DRAWING. SPAR/GOVERNMENT SOURCE INSPECTION IS ENVOKED ON ALL BEARING PROCUREMENTS FOR THE SRMS. 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, 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 ENVOKED ON ALL BEARING PROCUREMENTS. 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 GOVENMENT 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. JOINT LEVEL PRE-ACCEPTANCE TEST INSPECTION, INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERTFICATION TO AS DESIGN ETC. JOINT LEVEL ACCEPTANCE TESTING (ATP) INCLUDES AMBINET, VIBRATION AND THERMAL-VAC TESTING.

PREPARED BY: MEHC SUPERSEDING DATE: 11 FEB 84 APPROVED BY

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MOTOR MODULE
SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1214
SHEET: 4

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
4070	0	MOTOR MODULE BEARINGS QTY-6 51140D1212-1 D2096-3 D2095-3 D1924-1	MODE: DEGRADED TORQUE OUTPUT FROM MOTOR DRIVE. CAUSE(S): (1) HIGH BEARING FRICTION. (2) LUBRICATION BREAKDOWN OR FAILURE OF SEAL (D1924) (3) LOSS OF BEARING PRELOAD.	DEGRADED OR NO MOTION OF JOINT (SLUGGISH OR FROZEN). ARM MAY TAKE AN UNEXPECTED TRAJECTORY. SPA MAY COMPENSATE WITH HIGHER CURRENT TO MOTOR. MAY LOSE ALL MODES. WORST CASE ---------- UNEXPECTED MOTION. FROZEN JOINT. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING ---------- N/A		(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)

PREPARED BY: MFWG
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: 51140ET214
SHEET: 5

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. I/F CRITICALITY	RATIONALE FOR ACCEPTANCE
4070	1	MOTOR MODULE BEARINGS QTY-6 51140D1212-1 D2094-3 D2095-3 D1924-1	MODE: DEGRADED TORQUE OUTPUT FROM MOTOR DRIVE. CAUSE(S): (1) HIGH BEARING FRICTION. (2) LUBRICATION BREAKDOWN OR FAILURE OF SEAL (D1924) (3) LOSS OF BEARING PRELOAD.	DEGRADED OR NO MOTION OF JOINT (SLUGGISH OR FROZEN). ARM MAY TAKE AN UNEXPECTED TRAJECTORY. SPA MAY COMPENSATE WITH HIGHER CURRENT TO MOTOR. MAY LOSE ALL MODES. WORST CASE --- UNEXPECTED MOTION. FROZEN JOINT. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING --- N/A		FAILURE HISTORY --- THE FOLLOWING FAILURE ANALYSIS REPORT(S) ARE RELEVANT: FAR 2020: S/N 201-7 DEC 78 DESCRIPTION --- FAILED STICTION, CAUSED BY INSUFFICIENT RUN-IN AND HIGH BEARING PRE-LOAD CORRECTIVE ACTION --- RAN-IN UNIT, ADJUSTED PRE-LOAD. FAR 2025: S/N 201-7 NOV 78 DESCRIPTION --- YAW JOD, BACK DRIVE BREAKOUT TORQUE EXCESSIVE DUE TO INHERENT STICTION OF M/M. CORRECTIVE ACTION --- MOD. M/M REFER TO FAR 2047 FAR 2028: S/N 202-7 DEC 78 DESCRIPTION --- FAILED TO BREAK-OUT, DUE TO INCORRECT RUN-IN, NON-FLIGHT BRAKE, INHERENT HIGH STICTION OF M/M. CORRECTIVE ACTION --- CHANGED BRAKE RUN-IN UNIT, MOD. M/M TO FAR 2047. FAR 2032: S/N 202-7 DEC 78 DESCRIPTION --- UNIT STALLED AT -250C, HIGH STICTION DUE TO INCORRECT RUN-IN ON BEARING, BRAKE BEARING, INHERENT HIGH STICTION. CORRECTIVE ACTION --- REFER TO FAR 2047 FAR 2038: S/N 202-5 JAN 79

PREPARED BY: MFWG
SUPERCEDING DATE: 06 OCT 87
APPROVED BY:

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MOTOR MODULE
SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1214
SHEET: 6

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. I/I CRITICALITY	RATIONALE FOR ACCEPTANCE
4070	1	MOTOR MODULE BEARINGS QTY-6 51140D1212-1 D2094-3 D2095-3 D1924-1	MODE: DEGRADED TORQUE OUTPUT FROM MOTOR DRIVE. CAUSE(S): (1) HIGH BEARING FRICTION. (2) LUBRICATION BREAKDOWN OR FAILURE OF SEAL (D1924) (3) LOSS OF BEARING PRELOAD.	DEGRADED OR NO MOTION OF JOINT (SLUGGISH OR FROZEN). ARM MAY TAKE AN UNEXPECTED TRAJECTORY. SPA MAY COMPENSATE WITH HIGHER CURRENT TO MOTOR. MAY LOSE ALL MODES. WORST CASE --- UNEXPECTED MOTION. FROZEN JOINT. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING --- N/A		DESCRIPTION --- HIGH STICTION DUE TO ORY LUBE DEBRIS IN SR 545 BEARING CORRECTIVE ACTION --- RETURNED TO SPERRY, CLEANED BEARING, RE-TESTED. FAR 2042: S/N 202-7 FEB 79 DESCRIPTION --- HIGH STICTION DUE TO INSUFFICIENT CLEARANCE BETWEEN DUCT COVER AND DRIVE SHAFT CORRECTIVE ACTION --- INCREASED CLEARANCES, ECN 51140-1465 FAR 2043: S/N 202-7 FEB 79 DESCRIPTION --- UNIT FAILED TO BREAK-OUT, DUE TO INTERFERENCE AT LOW TEMP AT CSA END GAP. CORRECTIVE ACTION --- INCREASED CLEARANCE ECN 51140-1486, 1718. FAR 2047: S/N 201-7 FEB 79 DESCRIPTION --- UNIT SEIZED (330F) DUE TO :DIAPHRAM SPRING NOT STIFF ENOUGH. AXIAL PRE-LOAD TOO HIGH BEARING CAGE DRAGGING ON INNER RACE. BALL POCKETS TOO SMALL. INADEQUATE DEBURRING OF BALL POCKETS. CORRECTIVE ACTION --- RELAXED STICTION REQUIREMENTS, ECR M194-R1, SUBSTITURE "O" RING FOR DIAPHRAM SPRING. REDUCED PRE LOAD MOD BEARING ECN 51140-1554, 1573, 1571, 1572, 1586 FAR 2066: S/N 213 MAY 79 BINDING CAUSED BY BEARING FAILURE RESULTING FROM INCORRECT PRE-LOAD AND INADEQUATE RUN-IN. CORRECTIVE ACTION --- REPLACED BRG, RE-ISSUED PPS 28:14 ON RUN-IN

PREPARED BY: MEHG
SUPERCEDING DATE: 06 OCT 87
APPROVED BY:
DATE:

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MOTOR MODULE
SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1214
SHEET: 7

FMEA REF.	REV.	NAME, QTY. & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. I/I CRITICALITY	RATIONALE FOR ACCEPTANCE
4070	1	MOTOR MODULE BEARINGS QTY-6 51140D1212-1 D2094-3 D2095-3 D1924-1	MODE: DEGRADED TORQUE OUTPUT FROM MOTOR DRIVE. CAUSE(S): (1) HIGH BEARING FRICTION. (2) LUBRICATION BREAKDOWN OR FAILURE OF SEAL (D1924) (3) LOSS OF BEARING PRELOAD.	DEGRADED OR NO MOTION OF JOINT (SLUGGISH OR FROZEN). ARM MAY TAKE AN UNEXPECTED TRAJECTORY. SPA MAY COMPENSATE WITH HIGHER CURRENT TO MOTOR. MAY LOSE ALL MODES. WORST CASE --- UNEXPECTED MOTION. FROZEN JOINT. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING --- N/A		FAR 2067: S/N 201-1 MAY 79 DESCRIPTION --- FAILED TO BREAK-OUT DUE TO IMPACTED D1212 AND D1213 BEARINGS AND TEFLON SEAL BREAKDOWN OF SR CORRECTIVE ACTION --- REMOVED TEFLON SEAL FROM ALL BRAKE BEARING. REPLACED D1212, D1213, BEARING FAR 2071: S/N 202-1 JUN 79 DESCRIPTION --- HIGH STICTION DUE TO BRAKE SR 545 TEFLON SEAL DETERIORATION CORRECTIVE ACTION --- REFER TO FAR 2086 FAR 2077: S/N 202-5 JUN 79 STICTION TOO HIGH, CAUSED BY TEFLON FLAKES IN BRAKE. (REFER TO FAR 2086). CORRECTIVE ACTION --- REMOVE TEFLON SEAL FROM SR 545 BEARING. RETROFIT ALL BRAKES FAR 2078: S/N 203 JUN 79 DESCRIPTION --- HIGH STICTION, DRY LUBE DEBRIS IN BEARING. REFER TO FAR 2071 CORRECTIVE ACTION --- REFER TO FAR 2086. FAR 2086: S/N 201-7 APR 79 DESCRIPTION --- BRAKE HAD HIGH STICTION (REF. FAR 2058) CAUSED BY TEFLON FLAKES IN BRAKE SR 545 BEARING CORRECTIVE ACTION --- REMOVED TEFLON SEAL FROM BEARING REWORK ALL MOTORS. FAR 2091:

PREPARED BY: MFMG
SUPERCEDING DATE: 06 OCT 87
APPROVED BY:

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MOTOR MODULE

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140ET214

SHEET: 8

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. I/I CRITICALITY	RATIONALE FOR ACCEPTANCE
4070	1	MOTOR MODULE BEARINGS QTY-6 51140D1212-1 D2094-3 D2095-3 D1924-1	MODE: DEGRADED TORQUE OUTPUT FROM MOTOR DRIVE. CAUSE(S): (1) HIGH BEARING FRICTION. (2) LUBRICATION BREAKDOWN OR FAILURE OF SEAL (D1924) (3) LOSS OF BEARING PRELOAD.	DEGRADED OR NO MOTION OF JOINT (SLUGGISH OR FROZEN). ARM MAY TAKE AN UNEXPECTED TRAJECTORY. SPA MAY COMPENSATE WITH HIGHER CURRENT TO MOTOR. MAY LOSE ALL MODES. WORST CASE --- UNEXPECTED MOTION. FROZEN JOINT. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING --- N/A		S/N 202-5 JUL 79 DESCRIPTION --- HIGH STICTION OF BRAKE S/N 202-3 (REF: FAR 207) CORRECTIVE ACTION --- REFER TO FAR 2086. FAR 2095: S/N 202-1 NOV 79 DESCRIPTION --- HIGH STICTION DUE TO: EXCESS DRY LUBE IN D1211 BEARING, INCORRECT CSA TIMING, HIGH STICTION IN BRAKE. CORRECTIVE ACTION --- REPLACED D1211 BEARING, REPLACED BRAKE CORRECTED TM 1591 CSA TIMINNG INSTRUCTIONS. FAR 2096: S/N 204 NOV 79 DESCRIPTION --- HIGH STICTION CAUSED BY EXCESS DRY LUBE DEBRIS. CORRECTIVE ACTION --- REPLACED BEARING, BRAKE QUARANTINED, REUSED FAR 2097: S/N 207 NOV 79 DESCRIPTION --- HIGH STICTION (FAR 2095) DUE TO SWARF ON SHAFT/INNER RACE DRAGGING CORRECTIVE ACTION --- IMPROVED WORKMANSHIP DIRECTIONS. FAR 2104: S/N 207-5 JAN 80 DESCRIPTION --- HIGH STICTION CAUSED BY EXCESS DRY LUBE DEBRIS AND OVALITY OF SR 545 BEARING (REFER TO FAR 2097.) CORRECTIVE ACTION --- REPLACE BEARING RETEST. FAR 2109:

PREPARED BY: MFWG SUPERCEDING DATE: 06 OCT 87 APPROVED BY: _____ DATE: _____

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MOTOR MODULE
SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 5114OET214
SHEET: 9

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. I/I CRITICALITY	RATIONALE FOR ACCEPTANCE
4070	1	MOTOR MODULE BEARINGS QTY-6 5114OD1212-1 D2094-3 D2095-3 D1924-1	MODE: DEGRADED TORQUE OUTPUT FROM MOTOR DRIVE. CAUSE(S): (1) HIGH BEARING FRICTION. (2) LUBRICATION BREAKDOWN OR FAILURE OF SEAL (D1924) (3) LOSS OF BEARING PRELOAD.	DEGRADED OR NO MOTION OF JOINT (SLUGGISH OR FROZEN). ARM MAY TAKE AN UNEXPECTED TRAJECTORY. SPA MAY COMPENSATE WITH HIGHER CURRENT TO MOTOR. MAY LOSE ALL MODES. WORST CASE --- UNEXPECTED MOTION. FROZEN JOINT. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING --- N/A		S/N 202-7 JUN 80 DESCRIPTION --- HIGH STICTION DUE TO DRY LUBE DEBRIS ON BRAKE S/N 204-1. REFER TO FAR 2096. CORRECTIVE ACTION --- BEARING, CLEANED UNIT RETESTED FAR 2115: S/N 201-9 JUN 80 DESCRIPTION --- FAILED TO BREAK-OUT AT 8.0 OZ.IN. (OK AT 9.0 OZ.IN.) SUSPECT. CORRECTIVE ACTION --- NONE FAR 2307: S/N 307 NOV 81 DESCRIPTION --- SHAFT LOCKED, METAL DEBRIS IN BEARING, POOR WORKMANSHIP. CORRECTIVE ACTION --- BEARING REPL IMPROVED INSPECTION. (FMEA NO. 3990, 4070) FAR 2311: S/N 301-9 FEB 82 DESCRIPTION --- FAILED TO BREAK OUT EXCESS BALLS IN D2094-1 BRG, DRY LUBE IN D1930-1 BRG. CORRECTIVE ACTION --- REPLACED WITH NEW WET LUBED BEARINGS. FAR 2323: S/N 302-1 JUN 82 DESCRIPTION --- STICTION TOO HIGH, FAULTY D1212 (DRY LUBE) BEARING. CORRECTIVE ACTION --- REPLACED BEARING AND BRAKE. FAR 2357: F2357

PREPARED BY: MFMG
SUPERCEDING DATE: 06 OCT 87
APPROVED BY: ___

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MOTOR MODULE
SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1214
SHEET: 10

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. I/F CRITICALITY	RATIONALE FOR ACCEPTANCE
4070	1	MOTOR MODULE BEARINGS QTY-6 51140D1212-1 D2094-3 D2095-3 D1924-1	MODE: DEGRADED TORQUE OUTPUT FROM MOTOR DRIVE. CAUSE(S): (1) HIGH BEARING FRICTION. (2) LUBRICATION BREAKDOWN OR FAILURE OF SEAL (D1924) (3) LOSS OF BEARING PRELOAD.	DEGRADED OR NO MOTION OF JOINT (SLUGGISH OR FROZEN). ARM MAY TAKE AN UNEXPECTED TRAJECTORY. SPA MAY COMPENSATE WITH HIGHER CURRENT TO MOTOR. MAY LOSE ALL MODES. WORST CASE --- UNEXPECTED MOTION. FROZEN JOINT. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING --- N/A	FAR 2364: S/N 303-1 AUG 83 DESCRIPTION --- BRAKE SLIP TORQUE TOO HIGH. REFER TO FAR 2357. CORRECTIVE ACTION --- REFER TO FAR 2337. FAR 2384: S/N 201 AUG 85 DESCRIPTION --- PITCH RATE ERRORS. FOUND BRAKE BEARING CONTAMINATED WITH BRAKE DUST. CORRECTIVE ACTION --- REMOVED ALL, DRY LUBE BRAKES FROM SYSTEM (D1930 BRGS) FAR 2389: S/N 202-5 NOV 85 DESCRIPTION --- RUNNING FRICTION TOO HIGH. DEBRIS AT TACH INTERFACE CORRECTIVE ACTION --- REPLACED TACH FAR 2398: S/N 201/M1 MAY 87 DESCRIPTION --- RUNNING FRICTION HIGH. CORRECTIVE ACTION --- REPLACED BRAKES (2). FAR 5001 S/N 202 MAR 79 DESCRIPTION --- FAILED BEARING PRELOAD, AIR GAP MEAS. DUE TO DAMAGE RESULTING FROM TEST CORRECTIVE ACTION --- ECN TO IMPROVE SPRING. REWORK ALL UNITS

PREPARED BY: MFWG SUPERCEDING DATE: 06 OCT 87 APPROVED DATE:

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: MOTOR MODULE
SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51T40E1214
SHEET: 11

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 1/1 CRITICALITY — RATIONALE FOR ACCEPTANCE
4070	0	MOTOR MODULE BEARINGS QTY-6 51T40D1212-1 D2094-3 D2095-3 D1924-1	MODE: DEGRADED TORQUE OUTPUT FROM MOTOR DRIVE. CAUSE(S): (1) HIGH BEARING FRICTION. (2) LUBRICATION BREAKDOWN OR FAILURE OF SEAL (D1924) (3) LOSS OF BEARING PRELOAD.	DEGRADED OR NO MOTION OF JOINT (SLUGGISH OR FROZEN). ARM MAY TAKE AN UNEXPECTED TRAJECTORY. SPA MAY COMPENSATE WITH HIGHER CURRENT TO MOTOR. MAY LOSE ALL MODES. WORST CASE ---------- UNEXPECTED MOTION. FROZEN JOINT. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS REMAINING ---------- N/A	OPERATIONAL EFFECTS ---------- ONE JOINT STOPS. ARM DOES NOT RESPOND PROPERLY TO COMMANDS. FOR HAND CONTROLLER COMMANDS CREW INHERENTLY COMPENSATE FOR ANY UNDESIRED TRAJECTORIES. CREW ACTION ---------- APPLY BRAKES. USE SINGLE MODE ON OTHER JOINTS TO POSITION ARM FOR JETTISON. 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. 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 SAFETY PERFORMED. SCREEN FAILURES ---------- N/A OMRSD OFFLINE ---------- IN DIRECT DRIVE WITH ELBOW DEMATED VERIFY RATES FOR ALL JOINTS OMRSD ONLINE INSTALLATION ---------- NONE OMRSD ONLINE TURNAROUND ---------- NONE

PREPARED BY: MFWG
SUPERCEDING DATE: 11 SEP 86
APPROVED BY: