CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: ROTATIONAL HAND CONTROLLER
SYSTEM: D&C SUBSYSTEM
ASS'Y P/N: 5115SE117
SHEET:

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
1500	1	RATE HOLD SWITCH QTY-1 P/N 10056487	MODE: FAILURE OF RATE HOLD. CAUSE(S): (1) 10V CONTACT S/C. (2) POLE FAILS TO 10V. (3) 10V CONTACT O/C. (4) POLE FAILS TO 0V.	EFFECT 1 CAUSE (1&2) IF SWITCH WAS OPEN: (A) IF CURRENTLY IN RATE HOLD, WILL DROP OUT OF RATE HOLD PERMANENTLY. (B) IF CURRENTLY OUT OF RATE HOLD, WILL GO INTO RATE HOLD UNTIL DROP OUT OF MODE. EFFECT 2 CAUSE (1&2) IF SWITCH WAS CLOSED: (C) IF CURRENTLY IN RATE HOLD, WILL REMAIN IN RATE HOLD UNTIL DROP OUT OF MODE. (D) IF CURRENTLY OUT OF RATE HOLD WILL BE OUT OF RATE HOLD PERMANENTLY. EFFECT 3 CAUSE (3&4) IF SWITCH WAS OPEN: (C) AND (D) APPLY. EFFECT 4 CAUSE (3 & 4) IF SWITCH WAS CLOSED: (A) AND (B) APPLY. WORST CASE ..... UNEXPECTED MOTION. & JOINT RUNAWAY. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS		DESIGN FEATURES ..... THE RATE HOLD SWITCH IS AN ALTERNATE ACTION PUSH BUTTON SWITCH PROCURED UNDER THE CONTROL OF HONEYWELL SPECIFICATION 10056487. TEN SAMPLES TAKEN FROM A HOMOGENEOUS PRODUCTION LOT WERE SUBJECTED TO QUALIFICATION TESTING. THE TEST PROGRAM INCLUDED - SOLDERABILITY, THERMAL SHOCK, RANDOM VIBRATION, MOISTURE RESISTANCE, 25000 OPERATING CYCLES AT 2 AMPS, 50000 CYCLES AT 0.01 AMP, CONTACT RESISTANCE AND INSULATION RESISTANCE. REPRESENTATIVE SWITCHES AND ACTUATORS WERE LIFE TESTED FOR SRMS USE. THIS TEST WAS CONDUCTED BY MOUNTING THE SWITCHES IN A REPRESENTATIVE HAND GRIP FRAME. TESTING INCLUDED - RANDOM VIBRATION TO QVT LEVELS AND OPERATING LIFE TESTS TO 10000 CYCLES (5000 BEFORE VIBRATION, AND 5000 POST-VIBRATION) CONTACT RESISTANCE, AND ACTUATOR OPERATING FORCES. FOR SWITCH OPERATIONAL CYCLES REFER TO TABLE 13. SOLDERED CONNECTIONS TO THE SWITCHES ARE POTTED TO AFFORD STRAIN RELIEF, AND PROTECTION AGAINST SHORT CIRCUIT. THE PROCUREMENT SPECIFICATION FOR THE SWITCH INCLUDES THE REQUIREMENT FOR QPA ON SAMPLES FROM EACH DELIVERED LOT.

PREPARED BY: MFWG
SUPERCEDING DATE: 01 OCT 86
APPROVED BY:
DATE:

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: ROTATIONAL HAND CONTROLLER
SYSTEM: D&C SUBSYSTEM
ASS'Y P/N: 51155ET17

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
1500	1	RATE HOLD SWITCH QTY-1 P/N 10056487	MODE: FAILURE OF RATE HOLD. CAUSE(S): (1) 10V CONTACT S/C. (2) POLE FAILS TO 10V. (3) 10V CONTACT O/C. (4) POLE FAILS TO 0V.	REMAINING --- N/A		ACCEPTANCE TESTS --- THE RHC IS SUBJECTED TO THE FOLLOWING ACCEPTANCE ENVIRONMENTAL TESTING AS AN SRU. O VIBRATION: LEVEL AND DURATION REFERENCE TABLE 1 O THERMAL: +120 DEGREES F TO 20 DEGREES F (12 HRS PER CYCLE) 2 CYCLES TOTAL. THE RHC IS TESTED AS PART OF THE D&C SUBSYSTEM; WHICH CONSIST OF D&C PANEL, THC AND RHC; PER TP 347. THE TOTAL D&C SUBSYSTEM UNDERGOES RMS SYSTEM TESTING, (TP 518 RMS STRONGBACK, AND TP552 FLAT FLOOR TESTS) WHICH VERIFIES THE ABSENCE OF THE FAILURE MODE. QUALIFICATIONS TESTS --- THE RHC IS CERTIFIED BY SIMILARITY TO THE ORBITER USED RHC EXCEPT FOR FINGER OPERATED SWITCHES. THE BASIC DIFFERENCES IS THAT THE ORBITER RHC IS TRIPLE REDUNDANT AND THE RMS RHC IS SINGLE STRING. FLIGHT CHECKOUT --- PDRS OPS CHECKLIST (ALL VENICLES) JSC 16987

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CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: ROTATIONAL HAND CONTROLLER
SYSTEM: D&C SUBSYSTEM
ASS'Y P/N: 51155ET17
SHEET: 3

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
1500	1	RATE HOLD SWITCH QTY-1 P/N 10056487	MODE: FAILURE OF RATE HOLD. CAUSE(S): (1) 10V CONTACT S/C. (2) POLE FAILS TO 10V. (3) 10V CONTACT O/C. (4) POLE FAILS TO 0V.	EFFECT 1 CAUSE (1&2) IF SWITCH WAS OPEN: (A) IF CURRENTLY IN RATE HOLD, WILL DROP OUT OF RATE HOLD PERMANENTLY. (B) IF CURRENTLY OUT OF RATE HOLD, WILL GO INTO RATE HOLD UNTIL DROP OUT OF MODE. EFFECT 2 CAUSE (1&2) IF SWITCH WAS CLOSED: (C) IF CURRENTLY IN RATE HOLD, WILL REMAIN IN RATE HOLD UNTIL DROP OUT OF MODE. (D) IF CURRENTLY OUT OF RATE HOLD WILL BE OUT OF RATE HOLD PERMANENTLY. EFFECT 3 CAUSE (3&4) IF SWITCH WAS OPEN: (C) AND (D) APPLY. EFFECT 4 CAUSE (3 & 4) IF SWITCH WAS CLOSED: (A) AND (B) APPLY. WORST CASE ..... UNEXPECTED MOTION. 6 JOINT RUNAWAY. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS	QA/INSPECTIONS ..... PUSHBUTTON SWITCHES ARE PROCURED TO HONEYWELL SPECIFICATION 10056487. HONEYWELL PART NO. 10056487-101. QUALIFICATION TESTING OF THE SWITCH WAS CONDUCTED BY THE SWITCH MANUFACTURER C.P. CLARE AND CO., AS REQUIRED BY HONEYWELL SPECIFICATION 10056487. ADDITIONAL QUALIFICATION VIBRATION TESTING OF SWITCH WAS PERFORMED BY HONEYWELL TO SPEC 10056487. TEST RESULTS ARE COVERED IN HONEYWELL TEST REPORT NO. AEX-79-025. THE SWITCH MECHANISMS AND SWITCHES SUCCESSFULLY COMPLETED 10,000 CYCLES OF LIFE CYCLING. IN ADDITION TO THE 10,000 LIFE CYCLES, THE SWITCH MECHANISMS AND SWITCHES WERE SUBJECTED TO THE QAVT AND FLIGHT VIBRATION REQUIREMENTS OF CAE SPECIFICATION PS 87827.51. PRIOR TO ANY SWITCH CYCLING OR VIBRATION, SWITCH MECHANISMS SUBASSEMBLIES WERE GIVEN A FUNCTIONAL PERFORMANCE TEST ON THE SSHC TEST CONSOLE. DETAILED TEST RESULTS ARE COVERED IN HONEYWELL TEST REPORT NO. AEX-77-059. WIRE IS PROCURED TO SPECIFICATION MIL-W-22759 OR MIL-W-81381 AND INSPECTED AND TESTED TO NASA JSCM8080 STANDARD NUMBER 95A. RECEIVING INSPECTION VERIFIES THAT SWITCHES RECEIVED ARE AS IDENTIFIED IN THE PROCUREMENT DOCUMENTS, THAT NO PHYSICAL DAMAGE HAS OCCURRED TO SWITCHES DURING SHIPMENT, THAT THE RECEIVING DOCUMENTS PROVIDE ADEQUATE TRACEABILITY INFORMATION AND ACCEPTANCE TEST DATA IDENTIFIES ACCEPTABLE PARTS. PARTS ARE INSPECTED THROUGHOUT MANUFACTURE AND ASSEMBLY AS APPROPRIATE TO THE MANUFACTURING STAGE COMPLETED. THESE INSPECTIONS INCLUDE, 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 08800A. PRE-CLOSURE INSPECTION, WORKMANSHIP AND CLEANLINESS (CAE/GOVERNMENT REP. - 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 AND THERMAL TESTING (CAE/GOVERNMENT REP. - MANDATORY INSPECTION POINT) INTEGRATION OF D&C PANEL, RHC, THC AND MCIU, INSPECTIONS ARE PERFORMED AT EACH STAGE OF INTEGRATION, WHICH INCLUDES GROUNDING CHECKS, INTER CONNECT CABLE VERIFICATION, CONNECTOR INSPECTION FOR BENT OR PUSHBACK CONTACTS ETC. SUB-SYSTEM PERFORMANCE TESTING (ATP), INCLUDES AN AMBIENT PERFORMANCE TEST. (MANDATORY INSPECTION POINT).

PREPARED BY: MFWG
SUPERCEDING DATE: 01 OCT 86
APPROVED BY: _____ DATE: _____

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: ROTATIONAL HAND CONTROLLER
SYSTEM: D&C SUBSYSTEM
ASS'Y P/N: 51155E117
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
1500	1	RATE HOLD SWITCH QTY-1 P/N 10056467	MODE: FAILURE OF RATE HOLD. CAUSE(S): (1) 10V CONTACT S/C. (2) POLE FAILS TO 10V. (3) 10V CONTACT O/C. (4) POLE FAILS TO 0V.	REMAINING N/A		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: MEWG
SUPERCEDING DATE: 01 OCT 86
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CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: ROTATIONAL HAND CONTROLLER
SYSTEM: D&C SUBSYSTEM
ASS'Y P/N: 5T155E117
SHEET: 5

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
1500	1	RATE HOLD SWITCH QTY-1 P/N 10056487	MODE: FAILURE OF RATE HOLD. CAUSE(S): (1) 10V CONTACT S/C. (2) POLE FAILS TO 10V. (3) 10V CONTACT O/C. (4) POLE FAILS TO 0V.	EFFECT 1 CAUSE (1&2) IF SWITCH WAS OPEN: (A) IF CURRENTLY IN RATE HOLD, WILL DROP OUT OF RATE HOLD PERMANENTLY. (B) IF CURRENTLY OUT OF RATE HOLD, WILL GO INTO RATE HOLD UNTIL DROP OUT OF MODE. EFFECT 2 CAUSE (1&2) IF SWITCH WAS CLOSED: (C) IF CURRENTLY IN RATE HOLD, WILL REMAIN IN RATE HOLD UNTIL DROP OUT OF MODE. (D) IF CURRENTLY OUT OF RATE HOLD WILL BE OUT OF RATE HOLD PERMANENTLY. EFFECT 3 CAUSE (3&4) IF SWITCH WAS OPEN: (C) AND (D) APPLY. EFFECT 4 CAUSE (3 & 4) IF SWITCH WAS CLOSED: (A) AND (B) APPLY. WORST CASE --------- UNEXPECTED MOTION. 6 JOINT RUNAWAY. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS	FAILURE HISTORY --------- THERE HAVE BEEN NO FAILURES ASSOCIATED WITH THIS FAILURE MODE ON THE SRMS PROGRAM.	

PREPARED BY: MEWG
SUPERCEDING DATE: 01 OCT 86
APPROVED BY:
DATE:

CRITICAL ITEMS LIST

PROJECT: SAMS
ASS'Y NOMENCLATURE: ROTATIONAL HAND CONTROLLER
SYSTEM: D&C SUBSYSTEM
ASS'Y P/N: 5115S1117
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
1500	2	RATE HOLD SWITCH QTY-1 P/N 1005640?	MODE: FAILURE OF RATE HOLD. CAUSE(S): (1) 10V CONTACT S/C. (2) POLE FAILS TO 10V. (3) 10V CONTACT O/C. (4) POLE FAILS TO 0V.	EFFECT 1 CAUSE (1&2) IF SWITCH WAS OPEN: (A) IF CURRENTLY IN RATE HOLD, WILL DROP OUT OF RATE HOLD PERMANENTLY. (B) IF CURRENTLY OUT OF RATE HOLD, WILL GO INTO RATE HOLD UNTIL DROP OUT OF MODE. EFFECT 2 CAUSE (1&2) IF SWITCH WAS CLOSED: (C) IF CURRENTLY IN RATE HOLD, WILL REMAIN IN RATE HOLD UNTIL DROP OUT OF MODE. (D) IF CURRENTLY OUT OF RATE HOLD WILL BE OUT OF RATE HOLD PERMANENTLY. EFFECT 3 CAUSE (3&4) IF SWITCH WAS OPEN: (C) AND (D) APPLY. EFFECT 4 CAUSE (3 & 4) IF SWITCH WAS CLOSED: (A) AND (B) APPLY. WORST CASE --- UNEXPECTED MOTION, & JOINT RUNAWAY. UNANNUNCIATED. CREW ACTION REQUIRED. REDUNDANT PATHS		OPERATIONAL EFFECTS --- THE ARM COULD BEGIN TO OPERATE WITH (OR CANNOT CANCEL) RATE HOLD AT ANY TIME WHILE COMMANDING IN A MANUAL AUGMENTED MODE. THE OPERATOR WILL DETECT AND INHERENTLY COMPENSATE. CREW ACTION --- APPLY BRAKES TO STOP ARM AND CANCEL THE RATE HOLD FUNCTION. 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 CONTRAINTS --- DO NOT OPERATE WITH RATE HOLD WITHIN 10 FT OF 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. SCREEN FAILURES --- N/A ONRSO OFFLINE --- EXERCISE RATE HOLD SWITCH VERIFY CHANGE OF STATE ONRSO ONLINE INSTALLATION --- NONE ONRSO ONLINE TURNAROUND --- EXERCISE RATE HOLD SWITCH VERIFY CHANGE OF STATE OF RATE HOLD BIT ON DATA BUS

PREPARED BY: RMS
SUPERCEDING DATE: 06 OCT 87
APPROVE
DATE: