

**CRITICAL ITEMS LIST**

PROJECT: SRMS (-5 MCIU INSTALLED)  
 ASS'Y NOMENCLATURE: D&C PANEL

SYSTEM: D&C SUBSYSTEM  
 ASS'Y P/N: 51140E391

SHEET: 1

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HWDR / FUNC. 2/1R CRITICALITY RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
120	1	BRAKE ON/OFF SWITCH QTY-1. P/N CAE 87836 ME452-0102 TYPE VII ED 92020 SHEET 1	<p>MODE: BRAKE SW SHORT TO GND.</p> <p>CAUSE(S):                      (1) BRAKE SW 28V CONTACT (TO MCIU) FAILS S/C.                      (2) BRAKE SW GND. CONTACT (TO MCIU) FAILS S/C.</p>	<p>BRAKE SW WILL SHORT TO GND. WILL BLOW 2 AMP FUSE. LOSS OF PRIMARY POWER. GPC TERMINATES I/O. MCIU SHUTS DOWN. ARM WILL BE HARDWIRE SAFED AND BRAKES WILL BE APPLIED. LIMPING LOST DURING END EFFECTOR CAPTURE.</p> <p>LOSS OF EE PRIMARY DRIVE MODES.</p> <p>IF FAILURE OCCURS WHEN BRAKES ON, NO EFFECT. WHEN SWITCH TAKEN TO OFF, 28V SHORTED TO GND. IF FAILURE OCCURS WHEN BRAKES OFF 28V SHORTED TO GND.</p> <p>IF FAILURE OCCURS WHEN BRAKES OFF, NO EFFECT. WHEN SWITCH TAKEN TO ON, 28V SHORTED TO GND. IF FAILURE OCCURS WHEN BRAKES ON, 28V SHORTED TO GND.</p> <p>WORST CASE                      -----                      LOSS OF MISSION. LOSS OF PRIMARY MODES.</p> <p>REDUNDANT PATHS REMAINING                      -----                      BACKUP</p>	<p>DESIGN FEATURES                      -----</p> <p>TOGGLE SWITCHES USED ON THE D&amp;C PANEL ARE HERMETICALLY SEALED, AND OF A MATURE AND PROVEN DESIGN. THESE SWITCHES ARE IN COMMON USE ON THE ORBITER VEHICLE.</p> <p>THE SWITCHES ARE CONTROLLED BY ROCKWELL INTERNATIONAL SPECIFICATION MC 452-0102 AND HAVE BEEN QUALIFIED TO THE REQUIREMENTS OF THIS SPECIFICATION.</p> <p>ELECTRICAL CONNECTIONS TO THE SWITCH ARE ACHIEVED BY MEANS OF SOLDERABLE TERMINALS.</p> <p>WIRING TO SWITCH TERMINALS UTILIZES NICKEL PLATED CONDUCTORS WITH A POLYAMID INSULATION. SOLDERING OF THE NICKEL PLATED WIRE TO THE SWITCH TERMINALS IS CONTROLLED BY CAE PROCESS SPECIFICATION PD 91059.</p> <p>THE WIRING HARNESS IS DESIGNED TO BE CAPABLE OF SEPARATE TESTING (FOR INSULATION RESISTANCE, DIELECTRIC STRENGTH, AND CONTINUITY).</p> <p>MOUNTING OF THE SWITCH TO THE D&amp;C PANEL IS BY MEANS OF A 15/32 NUT WHICH ENGAGES A THREADED BUSHING ON THE SWITCH. A KEVED WASHER PROVIDES ROTATION RESTRAINT. AFTER INSTALLATION AND TORQUING, THE NUT IS STAKED TO THE PANEL BY A BLOB OF EPOXY ADHESIVE. A STAINLESS STEEL GUARD PROTECTS THE SWITCH LEVER AGAINST DAMAGE OR INADVERTENT OPERATION.</p> <p>ANALYSIS OF THE BASIC PANEL STRUCTURE HAS DEMONSTRATED THAT THERE ARE NO RESONANCES IN THE RELEVANT VIBRATION FREQUENCY SPECTRUM. THIS ANALYSIS HAS BEEN VERIFIED BY VIBRATION TESTING OF THE D&amp;C PANEL ASSEMBLY.</p> <p>APPLICATION ANALYSIS HAS CONFIRMED THAT ADEQUATE ELECTRICAL STRESS MARGINS ARE ACHIEVED.</p> <p>AT THE PART LEVEL, QUALIFICATION/CERTIFICATION TESTING IS DEFINED BY ROCKWELL INTERNATIONAL SPECIFICATION MC452-0102. THIS TEST REQUIREMENT INCLUDES: INSULATION RESISTANCE, DIELECTRIC STRENGTH, CONTACT RESISTANCE, RANDOM VIBRATION (40 MINUTES PER AXIS), LEAKAGE AT ONE ATMOSPHERE DIFFERENTIAL PRESSURE, TOGGLE STRENGTH. FOR SWITCH OPERATIONAL CYCLES REFER TO TABLE 13.</p> <p>ALL UNITS ARE SUBJECTED TO ACCEPTANCE TESTS WHICH INCLUDE PRE-ACCEPTANCE RUN-IN, DIELECTRIC STRENGTH, INSTALLATION RESISTANCE, CONTACT RESISTANCE, ACCEPTANCE VIBRATION, SEAL TEST, VISUAL EXAMINATION, AND RADIOGRAPHIC INSPECTION.</p>

PREPARED BY: MFVG

SUPERCEDING DATE: 06 OCT 8

DATE: 24 JUL 91

CIL REV: 3

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT OR END ITEM	HOWR / FUNC. 2/1R CRITICALITY RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
120	1	BRAKE ON/OFF SWITCH QTY-1. P/N CAE 87036 ME452-0102 TYPE VII EO 92020 SHEET 1	<p>MODE: BRAKE SW SHORT TO GND.</p> <p>CAUSE(S): (1) BRAKE SW 28V CONTACT (TO MCIU) FAILS S/C.  (2) BRAKE SW GND. CONTACT (TO MCIU) FAILS S/C.</p>	<p>BRAKE SW WILL SHORT TO GND. WILL BLOW 2 AMP FUSE. LOSS OF PRIMARY POWER. GPC TERMINATES I/O. MCIU SHUTS DOWN. ARM WILL BE HARDWIRE SAFED AND BRAKES WILL BE APPLIED. LIMPING LOST DURING END EFFECTOR CAPTURE.</p> <p>LOSS OF EE PRIMARY DRIVE MODES.</p> <p>IF FAILURE OCCURS WHEN BRAKES ON, NO EFFECT. WHEN SWITCH TAKEN TO OFF, 28V SHORTED TO GND. IF FAILURE OCCURS WHEN BRAKES OFF 28V SHORTED TO GND.</p> <p>IF FAILURE OCCURS WHEN BRAKES ON, 28V SHORTED TO GND. IF FAILURE OCCURS WHEN BRAKES OFF, NO EFFECT. WHEN SWITCH TAKEN TO ON, 28V SHORTED TO GND. IF FAILURE OCCURS WHEN BRAKES ON, 28V SHORTED TO GND.</p> <p>WORST CASE ----- LOSS OF MISSION. LOSS OF PRIMARY MODES.  REDUNDANT PATHS REMAINING ----- BACKUP</p>	<p>ACCEPTANCE TESTS ----- THE HARDWARE ITEM IS SUBJECTED TO THE FOLLOWING ACCEPTANCE ENVIRONMENTAL TESTS AS PART OF THE D&amp;C PANEL ASSEMBLY.</p> <p>O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 1</p> <p>O THERMAL: +110 DEGREES F TO PLUS 10 DEGREES F (2 CYCLES - 9.5 HRS/CYCLE.)</p> <p>THE D&amp;C PANEL ASSEMBLY IS FURTHER TESTED AS PART OF THE RMS SYSTEM TESTS (TP518 RMS STRONGBACK TEST AND TP552 FLAT FLOOR TEST) WHICH VERIFIES THE ABSENCE OF THE FAILURE MODE.</p> <p>QUALIFICATION TESTS ----- THE SWITCH ITEM HAS BEEN QUALIFIED FOR ORBITER USE. THE D&amp;C PANEL ASSEMBLY HAS BEEN SUBJECTED TO THE FOLLOWING QUALIFICATION TEST ENVIRONMENTS.</p> <p>O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 1</p> <p>O SHOCK: 20G/11 MS - 3 AXES (6 DIRECTIONS)</p> <p>O THERMAL: 130 DEGREES F TO -23 DEGREES F (12 HRS PER CYCLE) (6 CYCLES)</p> <p>O HUMIDITY: 95% (120 DEGREES F TO 82 DEGREES F CYCLE IN 16 HRS) 10 CYCLES TOTAL.</p> <p>O ENC: MIL-STD-461 AS MODIFIED BY SL-E-0002 (TEST CE01, CE02, CE03, CS01 (DC/AC), CE03, CS01 (DC/AC), CS02, CS06, RE02 (B/N), RS02, RS03, RS04)</p> <p>FLIGHT CHECKOUT ----- PORS OPS CHECKLIST (ALL VEHICLES) JSC 16987</p>

PREPARED BY: MEWG

SUPERCEDING DATE: 06 OCT 87

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

DATE: 24 JUL 91

CIL REV: 3

FMEA REF.	FMEA REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT OR END ITEM	HWDR / FUNC. Z/1R CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
120	1	BRAKE ON/OFF SWITCH QTY-1, P/N CAE B7836 ME452-0102 TYPE VII ED 92020 SHEET 1	<b>MODE:</b> BRAKE SW SHORT TO GND.  <b>CAUSE(S):</b> (1) BRAKE SW 28V CONTACT (TO MCIU) FAILS S/C.  (2) BRAKE SW GND. CONTACT (TO MCIU) FAILS S/C.	BRAKE SW WILL SHORT TO GND. WILL BLOW 2 AMP FUSE. LOSS OF PRIMARY POWER. GPC TERMINATES I/O. MCIU SHUTS DOWN. ARM WILL BE HARDWIRE SAFED AND BRAKES WILL BE APPLIED. LIMPING LOST DURING END EFFECTOR CAPTURE.  LOSS OF EE PRIMARY DRIVE MODES.  IF FAILURE OCCURS WHEN BRAKES ON, NO EFFECT. WHEN SWITCH TAKEN TO OFF, 28V SHORTED TO GND. IF FAILURE OCCURS WHEN BRAKES OFF 28V SHORTED TO GND.  IF FAILURE OCCURS WHEN BRAKES OFF, NO EFFECT. WHEN SWITCH TAKEN TO ON, 28V SHORTED TO GND. IF FAILURE OCCURS WHEN BRAKES ON, 28V SHORTED TO GND.  WORST CASE ----- LOSS OF MISSION. LOSS OF PRIMARY MODES.  REDUNDANT PATHS REMAINING ----- BACKUP	QA/INSPECTIONS ----- HERMETICALLY SEALED TOGGLE SWITCHES ARE PROCURED TO ROCKWELL SPECIFICATION MC452-0102. AS REQUIRED BY CAE SPEC. PS-B7836. CAE PART NO. PSB7836; QUALIFICATION AND ACCEPTANCE TESTING OF SWITCHES IS PERFORMED TO R.I. SPEC. MC 452-0102.  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 TO FRONT PANEL INSPECTION, SOLDERING OF WIRES TO SWITCH CONTACTS, WIRE ROUTING, STRESS RELIEF OF WIRES ETC., OPERATORS AND INSPECTORS ARE TRAINED AND CERTIFIED TO NASA NHB 5300.4(3A) STANDARD, AS MODIFIED BY JSC08800A.  PRE-TEST INSPECTION OF D&C PANEL ASSY INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC. (SPAR/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 PERFORMANCE, THERMAL AND VIBRATION TESTING, (SPAR/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).  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)	

**CRITICAL ITEMS LIST**

PROJECT: SRMS (-5 MCIU INSTALLED)  
 ASS'Y NOMENCLATURE: D&C PANEL

SYSTEM: D&C SUBSYSTEM  
 ASS'Y P/N: 51140E391

SHEET: 4

FMEA REF.	FMEA REV.	NAME QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	CLASS / FUNC. CRITICALITY RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
120	1	BRAKE ON/OFF SWITCH QTY-1, P/N CAE 67836 ME452-0102 TYPE VII ED 92020 SHEET 1	<p>MODE: BRAKE SW SHORT TO GND.</p> <p>CAUSE(S):                      (1) BRAKE SW 28V CONTACT (TO MCIU) FAILS S/C.                      (2) BRAKE SW GND. CONTACT (TO MCIU) FAILS S/C.</p>	<p>BRAKE SW WILL SHORT TO GND. WILL BLOW 2 AMP FUSE. LOSS OF PRIMARY POWER. GPC TERMINATES I/O. MCIU SHUTS DOWN. ARM WILL BE HARDWIRE SAFED AND BRAKES WILL BE APPLIED. LIMPING LOST DURING END EFFECTOR CAPTURE.</p> <p>LOSS OF EE PRIMARY DRIVE MODES.</p> <p>IF FAILURE OCCURS WHEN BRAKES ON, NO EFFECT. WHEN SWITCH TAKEN TO OFF, 28V SHORTED TO GND. IF FAILURE OCCURS WHEN BRAKES OFF 28V SHORTED TO GND.</p> <p>IF FAILURE OCCURS WHEN BRAKES OFF, NO EFFECT. WHEN SWITCH TAKEN TO ON, 28V SHORTED TO GND. IF FAILURE OCCURS WHEN BRAKES ON, 28V SHORTED TO GND.</p> <p>WORST CASE                      -----                      LOSS OF MISSION. LOSS OF PRIMARY MODES.</p> <p>REDUNDANT PATHS REMAINING                      -----                      BACKUP</p>	<p>FAILURE HISTORY                      -----                      THERE HAVE BEEN NO FAILURES ASSOCIATED WITH THIS FAILURE MODE ON THE SRMS PROGRAM.</p>

PREPARED BY: MFWG SUPERSEDING DATE: 06 OCT 87 APPROVED BY: DATE: 24 JUL 91 CIL REV: 3

**CRITICAL ITEMS LIST**

PROJECT: SRMS (-5 MCIU INSTALLED)  
 ASS'Y NOMENCLATURE: D&C PANEL

SYSTEM: D&C SUBSYSTEM  
 ASS'Y P/N: 51140E391

SHEET: 5

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT OR END ITEM	HDWR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
120	1	BRAKE ON/OFF SWITCH QTY-1. P/N CAE 07836 ME452-0102 TYPE VII ED 92020 SHEET 1	MODE: BRAKE SW SHORT TO GND.  CAUSE(S): (1) BRAKE SW 28V CONTACT (TO MCIU) FAILS S/C.  (2) BRAKE SW GND. CONTACT (TO MCIU) FAILS S/C.	BRAKE SW WILL SHORT TO GND. WILL BLOW 2 AMP FUSE. LOSS OF PRIMARY POWER. GPC TERMINATES I/O. MCIU SHUTS DOWN. ARM WILL BE HARDWIRED SAFED AND BRAKES WILL BE APPLIED. LIMPING LOST DURING END EFFECTOR CAPTURE.  LOSS OF EE PRIMARY DRIVE MODES.  IF FAILURE OCCURS WHEN BRAKES ON, NO EFFECT. WHEN SWITCH TAKEN TO OFF, 28V SHORTED TO GND. IF FAILURE OCCURS WHEN BRAKES OFF 28V SHORTED TO GND.  IF FAILURE OCCURS WHEN BRAKES OFF, NO EFFECT. WHEN SWITCH TAKEN TO ON, 28V SHORTED TO GND. IF FAILURE OCCURS WHEN BRAKES ON, 28V SHORTED TO GND.  WORST CASE LOSS OF MISSION. LOSS OF PRIMARY MODES.  REDUNDANT PATHS REMAINING ----- BACKUP	OPERATIONAL EFFECTS ----- COMPUTER SUPPORTED MODES CANNOT BE USED TO COMPLETE THE MISSION. BACK-UP MODE REMAINS. IF PAYLOAD ATTACHED, THE ARM SHOULD BE MANEUVERED TO A SAFE POSITION FOR PAYLOAD RELEASE. IF WITH SUBSEQUENT FAILURES ALL DRIVE MODES ARE LOST, THE ARM MAY BE JETTISONED.  CREW ACTION ----- USE BACK-UP DRIVE.  CREW TRAINING ----- NONE  MISSION CONSTRAINTS ----- NONE  OMRSD OFFLINE ----- EXERCISE BRAKE SWITCH. VERIFY BRAKE VOLTAGE AT D&C PANEL OUTPUT.  OMRSD ONLINE INSTALLATION ----- EXERCISE BRAKE SWITCH. VERIFY BRAKE VOLTAGE AT LONGERON INTERFACE.  OMRSD ONLINE TURNAROUND ----- EXERCISE BRAKE SWITCH. VERIFY NUMERICAL READOUTS LIT.	

PREPARED BY: MFWG

SUPERCEDING DATE: 06 OCT 87

APPROVED BY:

DATE: 24 JUL 91

CIL REV: 3