

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 05-6-2491 -X**

**SUBSYSTEM NAME: ELECTRICAL POWER DISTRIBUTION & CONTROL
REVISION: 1 03/31/99**

PART DATA

| | PART NAME VENDOR NAME | PART NUMBER VENDOR NUMBER |
|-----|----------------------------------|--------------------------------------|
| LRU | : MEC 1 AND 2 | MC450-0016-0006 11901-607-71 |
| LRU | : MEC 1 AND 2 | MC450-0016-0008 |

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

MASTER EVENTS CONTROLLER (MEC) NON-CRITICAL OUTPUTS AND INTERLOCK CIRCUITRY POST ARMING.

REFERENCE DESIGNATORS: 54V76A13
55V76A14

QUANTITY OF LIKE ITEMS: 2

TWO MECS PER VEHICLE AND TWO CORES (A AND B) PER MEC

FUNCTION:

DRIVERS USED TO ENABLE CRITICAL SRB/ET/ORB IGNITION/SEPARATION FUNCTIONS, ATVC DEADFACE, CONTROL SWITCHING OF SRB BUS POWER, AND COMMAND PYROTECHNIC INITIATOR CONTROLLER (PIC) TEST SIGNALS AS WELL AS PROCESS PIC RESPONSE DATA FOR PYRO CIRCUIT VERIFICATION (REFERENCE ASSOCIATED MEC/PIC CILS: 05-6-2509-01, 05-6-2509-02, 05-6-2510-01 AND 05-6-2510-02).

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REVISION#: 1 03/31/99

SUBSYSTEM NAME: ELECTRICAL POWER DISTRIBUTION & CONTROL

LRU: MEC 1 AND 2

CRITICALITY OF THIS

ITEM NAME: MEC 1 AND 2

FAILURE MODE: 1R3

FAILURE MODE:

LOSS OF NON-CRITICAL OUTPUT (FIRE 3 COMMAND)

MISSION PHASE: PL PRE-LAUNCH
LO LIFT-OFFVEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:

PIECE PART FAILURE, CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY, THERMAL STRESS

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS
B) FAIL
C) PASS

PASS/FAIL RATIONALE:

A)

B)

FAILS "B" SCREEN BECAUSE REDUNDANT CORE OUTPUT COMMANDS ARE NOT MONITORED.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF FUNCTION (FIRE 3 COMMAND) TO ENABLE OR CONTROL CRITICAL FUNCTIONS IN MEC CORE A OR CORE B.

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(B) INTERFACING SUBSYSTEM(S):

LOSS OF REDUNDANCY FOR COMPLETION OF CRITICAL FUNCTIONS. LOSS OF QUALIFIER FOR FIRE 2 COMMAND FOR CORE A OR B FOR ONE OF TWO MASTER EVENT CONTROLLERS. NO EFFECT - THE OTHER CORE OR THE OTHER MEC WILL COMPLETE THE FUNCTION.

(C) MISSION:

FIRST FAILURE - NO EFFECT

(D) CREW, VEHICLE, AND ELEMENT(S):

FIRST FAILURE - NO EFFECT

(E) FUNCTIONAL CRITICALITY EFFECTS:

POSSIBLE LOSS OF CREW/VEHICLE AFTER THE THIRD FAILURE DUE TO FAILURE TO PERFORM A CRITICAL FUNCTION SUCH AS SRB OR ET SEPARATION VIA THE FOLLOWING SCENARIO:

- (1) LOSS OF A FIRE 3 COMMAND OUTPUT.
- (2) LOSS OF THE SAME FIRE 3 COMMAND OUTPUT FOR THE OTHER CORE IN THE SAME MEC.
- (3) FAILURE OF THE PYRO INITIATOR WHICH IS FIRED BY THE OTHER MEC.

ALSO POTENTIAL LOSS OF CREW/VEHICLE AFTER FOUR FAILURES (1) LOSS OF ONE MEC CORE OUTPUT TO A PIC COMMAND, (2) LOSS OF REDUNDANT CORE OUTPUT TO THE SAME PIC COMMAND AND (3) AND (4) LOSS OF CRITICAL PIC COMMANDS FROM BOTH CORES IN THE REDUNDANT MEC.

-DISPOSITION RATIONALE-

(A) DESIGN:

FUNCTIONAL DESCRIPTION

THE MASTER EVENTS CONTROLLER (MEC) CONSISTS OF AN INTERFACE WHICH RECEIVES COMMANDS FROM THE GENERAL PURPOSE COMPUTERS (GPC'S) VIA SEPARATE MULTIPLE INTERFACE ADAPTERS (MIA'S) AND A DOWNLINK WHICH TRANSMITS TEST AND MEASUREMENT DATA ON ONE CHANNEL TO ONE OF THE GPC'S. VALID COMMANDS ARE DECODED AND USED TO ENABLE THE REQUIRED PYRO INITIATOR CONTROLLER (PIC) INPUT COMMANDS. THERE ARE A MAXIMUM OF 57 CRITICAL COMMAND DATA WORDS AND ASSOCIATED DRIVERS TO THE INTERNAL AND REMOTE PIC'S. THE ELECTRICAL, ELECTRONIC AND ELECTROMECHANICAL COMPONENTS ARE SELECTED FROM OR IN ACCORDANCE WITH THE ORBITER PREFERRED PARTS LIST (OPPL) REQUIREMENTS. COMPONENT APPLICATIONS ARE EVALUATED TO ASSURE COMPLIANCE WITH DERATING REQUIREMENTS.

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PHYSICAL DESCRIPTION

THE DESIGN INCORPORATES RELIABILITY, MAINTAINABILITY, ENVIRONMENTAL AND TRANSPORTABILITY REQUIREMENTS AND OTHER DESIGN AND CONSTRUCTION PER SPECIFICATION MC450-0016.

THE CERTIFIED PART NUMBERS ARE MC450-0016-0005 AND MC450-0016-0008. DASH NUMBERS -0001 THROUGH -0005 ARE INACTIVE.

THE -0001 CONFIGURATION WAS INITIALLY BUILT FOR OV-102.

THE -0002 CONFIGURATION WAS INITIALLY BUILT FOR OV-99 AND CONTAINED AN UPGRADED MIA (MC515-0040-0004).

THE -0003 CONFIGURATION (INITIALLY BUILT FOR OV-103) WAS NEVER RELEASED FROM MANUFACTURING AND WAS REPLACED BY THE -0004 CONFIGURATION.

THE -0004 CONFIGURATION INCORPORATED A NUMBER OF CHANGES TO PRECLUDE INTERACTION BETWEEN INACTIVE DATA REGISTERS AND ACTIVE DATA REGISTERS CREATED BY TIME SKEW CONDITIONS. THIS PREVENTS SPURIOUS SIGNALS ON NON-CRITICAL OUTPUTS WITH NORMAL SYSTEM SKEWING. ADDITIONAL CIRCUIT CHANGES WERE IMPLEMENTED TO PRECLUDE INADVERTENT FIRING OF PIC CIRCUITS AND TO TOLERATE PREMATURE FIRE 2 COMMAND FAILURES. ANOTHER CHANGE WAS TO DELETE PIC'S 9 AND 10.

THE -0005 CONFIGURATION MODIFICATION CONSISTED OF ADDING BLEED RESISTORS ACROSS THE FIRE 2 PULSE TRANSFORMER OUTPUT CAPACITORS. THIS MODIFICATION INSURED THE PROPER MEC OUTPUTS TO PYRO DEVICES IN THE CASE OF AN INCOMPLETE FIRST FIRE 2/3 MESSAGE TO THE MEC FROM THE GPC.

THE -0006 CONFIGURATION INCORPORATED A SHIM MODIFICATION TO ELIMINATE A MODULE BOARD STRESS PROBLEM THAT CAUSED CRACKED SOLDER JOINTS IN SOME OF THE MODULE BOARD COMPONENTS.

THE -0008 CONFIGURATION INCORPORATES A MODIFICATION TO THE BOTTOM COVER TO PREVENT POTENTIAL INTERFERENCE WITH COMPONENTS.

**(B) TEST:
QUALIFICATION/CERTIFICATION**

CERTIFICATION TESTING AND ANALYSIS ARE COMPLETED AND APPROVED. QUALIFICATION TESTING (QUAL TEST REPORT C79-738/201) INCLUDING FULL FUNCTIONAL, THERMAL, VIBRATION, SHOCK, POWER, ELECTROMAGNETIC COMPATIBILITY (EMC), THERMAL VACUUM, AND LIFE HAS BEEN PERFORMED.

ACCEPTANCE AND SCREENING

EACH UNIT IS SUBJECTED TO ACCEPTANCE TEST PROCEDURE (ML0101-0105) AT THE REPAIR CENTER INCLUDING VISUAL EXAMINATION, FULL FUNCTIONAL, ACCEPTANCE THERMAL TEST (ATT) AND ACCEPTANCE VIBRATION TEST (AVT).

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GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

RECEIVING INSPECTION VERIFIES ALL INCOMING PARTS AND MATERIALS, INCLUDING PERFORMANCE OF VISUAL AND DIMENSIONAL EXAMINATIONS, IN ACCORDANCE WITH REQUIREMENTS. CERTIFICATION RECORDS AND TEST REPORTS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES.

CONTAMINATION CONTROL

A CONTROLLED WORK AREA IS UTILIZED FOR ASSEMBLY AND TEST. QUALITY CONTROL (QC) VERIFIES PROPER MAINTENANCE OF CLEANLINESS CONTROL.

ASSEMBLY/INSTALLATION

INSPECTION POINTS ARE DETERMINED BY QUALITY ENGINEERING IN ACCORDANCE WITH APPLICABLE REQUIREMENTS AND ARE DOCUMENTED ON INSPECTION PLANNING. WORK STATION DISCIPLINES ADHERED TO AND OBSERVED MORE THAN FIVE TIMES PER WEEK BY QC.

CRITICAL PROCESSES

ALL CRITICAL PROCESSES AND CERTIFICATIONS ARE MONITORED AND VERIFIED BY QC AS PROCESS CONTROL SURVEILLANCE ACTIVITY (OPERATIONS AUDIT). THE CRITICAL PROCESSES ARE SOLDERING, BONDING OF COMPONENTS FOR MECHANICAL STABILITY/THERMAL CONDUCTIVITY, COMPONENT PLACEMENT, WIRE ROUTING, AND CRIMPING. FORMAL CERTIFICATION FOR SOLDERING AND QUALIFICATION FOR CRIMPING ARE MAINTAINED.

TESTING

ACCEPTANCE TESTS, INCLUDING VIBRATION, THERMAL AND INSULATION RESISTANCE (IR), ARE OBSERVED AND VERIFIED BY QC.

HANDLING/PACKAGING

HANDLING OF CMOS/MOS DEVICES TO PRECLUDE ELECTROSTATIC DISCHARGE (ESD) VERIFIED BY QC. PARTS PACKAGED AND PROTECTED ARE VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS.

(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE. THE FAILURE HISTORY DATA PROVIDED BELOW IS NO LONGER BEING KEPT UP-TO-DATE.

MC450-0016-0002 CONFIGURATION

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FAILURE MODE: LOSS OF OUTPUT

CAR AC5363 (OV-099)

DURING ORBITER OV-099 SYSTEMS CHECKOUT TESTS, THE MEC EXHIBITED NON-CRITICAL COMMAND AND WRAP-AROUND TEST FAILURES. THE FAILURE WAS ISOLATED TO THE CHANNEL 1 DATA SHIFT SIGNAL FROM MEC MODULE II. TROUBLESHOOTING INDICATED THE PROBLEM TO BE IN THE AREA OF THREE IC'S (U113, U119 AND U120). THESE DEVICES WERE REMOVED AND RETESTED AND FOUND TO BE FUNCTIONING CORRECTLY. THE FAILURE WAS ATTRIBUTED TO UNOBSERVED SURFACE CONTAMINATION THAT WAS CLEARED DURING THE TROUBLESHOOTING PROCESS. THE FAILURE IS CONSIDERED TO BE AN ISOLATED INCIDENT.

MC450-0016-0004 CONFIGURATION

FAILURE MODE: LOSS OF OUTPUT

CARS AC6211/AC6537

DURING MEC CONFIRMATION TESTS IN THE FLIGHT SYSTEMS LAB (FSL)/ SHUTTLE AVONICS INTEGRATION LAB (SAIL), THE MEC EXHIBITED CORE A FAILURES. THE ANOMALIES WERE FOUND TO BE CAUSED BY BROKEN JUMPER WIRES. THE FAILURES WERE DETERMINED TO BE A HANDLING PROBLEM AND CONSIDERED TO BE ISOLATED INCIDENTS. THE FSL TEST SEQUENCE WAS ESTABLISHED AS PART OF THE ACCEPTANCE TEST PHASE FOR THE -0004 AND -0005 CONFIGURATION UNTIL THE SUPPLIER ACCEPTANCE TEST PROCEDURES WERE REVISED.

CAR AC7613 (OV-103)

DURING ORBITER OV-103 SYSTEMS CHECKOUT TESTS, THE MEC CORE B FAILED TO EXECUTE CRITICAL COMMANDS. THE FAILURE WAS ISOLATED TO MEC MODULE III IN THE AREA OF U67 PIN 23. THE IC WAS REMOVED AND REPLACED. THIS RESULTED IN THE LOSS OF THE FAILURE MODE BOTH AT THE BOARD AND COMPONENT LEVEL. THE ACTUAL CAUSE WAS NOT DETERMINED, BUT AVAILABLE DATA INDICATES THE MOST PROBABLE CAUSE TO BE SURFACE CONTAMINATION BETWEEN PINS 23 AND 24 OF THE IC WHICH ALLOWED SUFFICIENT CURRENT LEAKAGE TO CAUSE THE PROBLEM WHEN SUBJECTED TO TEMPERATURE AND/OR PRESSURE. THE PROBLEM WAS CONSIDERED TO BE AN ISOLATED INSTANCE.

CAR AC8479 (OV-099)

DURING OV-099 SUBSYSTEM CHECKOUT TESTS, THE MEC EXHIBITED AN EXTERNAL TANK SEPARATION CIRCUIT BITE ERROR. THE FAILURE WAS CAUSED BY A MISWIRE CONDITION WHICH PREVIOUSLY WOULD NOT HAVE BEEN CAUGHT AT THE MEC LEVEL. THE SUPPLIER'S ATP WAS REVISED TO CATCH FAILURES OF THIS NATURE.

CAR AC9773 (OV-103)

DURING ORBITER OV-103 SYSTEMS CHECKOUT TESTS, THE MEC SRB SEPARATION A ARM AND FIRE COMMANDS WERE NOT AVAILABLE. THE FAILURE WAS ISOLATED TO A SHORTED CERAMIC CAPACITOR MANUFACTURED BY REPUBLIC ELECTRONIC CORPORATION. THE SHORT WAS CAUSED BY A SOLDER TRACE ACROSS THE FACE OF THE CERAMIC DIELECTRIC. THIS IS THE ONLY RECORDED INSTANCE OF THIS CONDITION WITHIN A REPUBLIC ELECTRONIC CAPACITOR AND THEREFORE CONSIDERED AN ISOLATED INSTANCE.

CAR AC5525

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DURING SPECIAL SYSTEMS TESTS, THE MEC FAILED THE SOFTWARE EVALUATION TESTS. THE SUPPLIER RELEASED ECN'S TO CORRECT THE DESIGN DEFICIENCIES FOUND DURING THIS TEST. THESE CHANGES WERE INCORPORATED INTO ALL OF THE -0004 CONFIGURATIONS.

CAR AC8600 (FSSTL)

DURING SPECIAL TESTS ON THE FLIGHT SIMULATED SYSTEMS TEST LAB (FSSTL), THE MEC WOULD NOT PROCESS A NORMAL COMMAND WHEN THERE WAS AN INCOMPLETE OR PARTIAL COMMAND IN THE PRECEDING CYCLE. THE CONDITION WAS CORRECTED WITH THE ADDITION OF SIX BLEED RESISTORS TO THE MODULE III BOARDS. (CONFIGURATION CHANGE TO -0005).

MC45D-0016-0005 CONFIGURATION

FAILURE MODE: LOSS OF OUTPUT

CAR AD0802

DURING MEC TROUBLESHOOTING, PIC'S 4, 5 AND 6 FAILED TO FIRE AS REQUIRED. THE FAILURE WAS ISOLATED TO A POWER TRANSISTOR. TEARDOWN ANALYSIS REVEALED MELTED METALLIZATION ON THE EMITTER TRACE. THE SPECIFIC CAUSE FOR THIS CONDITION WAS NOT DETERMINED AS THE DEVICE WAS MISPLACED BY THE DEVICE MANUFACTURER. THIS IS THE ONLY RECORDED FAILURE OF THIS DEVICE AND CONSIDERED TO BE AN ISOLATED INSTANCE. THE PROGRAM HAS REPLACED ALL POWER TRANSISTORS WITH PIND TESTED TRANSISTORS.

CAR AD0578 (OV-102)

DURING ORBITER OV-102 SYSTEMS CHECKOUT TEST, MEC 2 CORE B SRB PIC FIRE COMMANDS WERE NOT PROCESSED. THE FAILURE WAS ISOLATED TO A LOOSE JUMPER WIRE AT U73 PIN 12 SOLDER PAD. THE CONDITION WAS ATTRIBUTED TO POOR WORKMANSHIP. THERE HAVE BEEN SIXTEEN SIMILAR FAILURES ATTRIBUTED TO SOLDER CONNECTIONS. THIRTEEN WERE EXPERIENCED DURING ACCEPTANCE TESTING AND THREE POST DELIVERY (INCLUDING THIS ONE). THE OTHER TWO POST DELIVERY SOLDER CONNECTION PROBLEMS (REFERENCE CAR'S AC8775 AND AD0578) SHOULD HAVE BEEN DETECTED IN ACCEPTANCE, HOWEVER, BECAUSE OF THE SIGNIFICANT DESIGN CHANGES THE ACCEPTANCE TEST PROCEDURE HAD NOT BEEN REVISED TO VERIFY ALL CIRCUIT PATHS. THE FSL OR FSSTL VERIFICATION WAS UTILIZED TO SUPPLEMENT ACCEPTANCE TESTING UNTIL THE ACCEPTANCE TEST PROCEDURE WAS REVISED.

INVESTIGATION DISCLOSED THAT THERE HAD BEEN SIX OTHER REPORTABLE JUMPER WIRE FAILURES; FIVE OF THE FAILURES HAD BEEN EXPERIENCED DURING ACCEPTANCE AND/OR FSL/FSSTL VERIFICATION TESTS AND ONE AT SAIL. REFERENCE CAR'S AD1104, AC9836, AC9465, AC6211, DR AB4975 AND CAR AC6537 (SAIL FAILURE).

THE SUPPLIER HAS BEEN AUTHORIZED TO REDESIGN FIVE MEC MODULE BOARDS ALONG WITH THE POWER SUPPLIES IN ORDER TO ELIMINATE A TOTAL OF 880 JUMPER WIRES. THIS WILL SIGNIFICANTLY REDUCE THE NUMBER OF SOLDER CONNECTIONS AND MAKE THE BOARDS MUCH EASIER TO INSPECT. THIS ACTION WAS EFFECTIVE FOR THE SPARE MEC'S, BEGINNING WITH S/N 011.

CAR AD0767

DURING ATP, A MEC FAILED THE RESPONSE DATA WORD REQUIREMENT. THE FAILURE CAUSE WAS AN OVERTORQUING CONDITION OCCURRING DURING THE INSTALLATION

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OF THE MODULE STABILIZATION SCREWS THROUGH THE BOTTOM PLATE THUS CRACKING THE SOLDER JOINTS AROUND THE NUTPLATE. A SHIM MODIFICATION WAS INCORPORATED TO ALLEVIATE THIS CONDITION.
(CONFIGURATION CHANGE TO -0006).

MC450-0016-0006 CONFIGURATION

FAILURE MODE: LOSS OF OUTPUT

CAR AD4537

DURING THE SUPPLIER'S INITIAL FUNCTIONAL TEST AT AMBIENT TEMPERATURE, THE OUTPUT AT A CONNECTOR PIN WAS "OFF" WHEN IT SHOULD BE "ON". REMOVAL OF AN UNNECESSARY ISOPAD AND REPLACEMENT OF THE U105 CHIP CORRECTED THE PROBLEM. THIS FAILURE MODE IS SCREENABLE AT THE ACCEPTABLE TEST LEVEL.

CAR AD4632

DURING THE FUNCTIONAL PORTION OF THE ATP, THE MEC EXPERIENCED A LOSS OF OUTPUT AT U46 PIN 10. REPLACEMENT OF THE U46 IC CORRECTED THE PROBLEM. ANALYSIS OF THIS CMOS NAND GATE COULD NOT FIND ANY DEFECTS. THE POSSIBILITY EXISTS THAT AN UNDETECTED CONTAMINANT WHICH WAS PRESENT IN THE SOLDER WAS LOST DURING PART REMOVAL. FURTHER ANALYSIS COULD NOT DETERMINE THE FAILURE CAUSE. THIS IS CONSIDERED TO BE AN ISOLATED FAILURE.

CAR AD4957

DURING ATP, A DRIVER SWITCH VOLTAGE DROP FAILURE WAS DISCOVERED. THE PROBLEM WAS TRACED TO TWO TRANSISTORS AND A DIODE WHICH WERE SHORTED. THE SUPPLIER FELT THAT THE MOST PROBABLE CAUSE WAS AN INTERNAL SHORT WITHIN THE Q35 TRANSISTOR CAUSING SECONDARY FAILURES IN TRANSISTOR Q36 AND DIODE CR109 AS WELL AS OVERSTRESSING INDUCTOR L5. ALL FOUR COMPONENTS WERE REPLACED. DUE TO THE LACK OF PREVIOUS FAILURES OF TRANSISTORS OF THIS TYPE, THIS FAILURE IS CONSIDERED TO BE AN ISOLATED OCCURENCE.

CAR AD5041

A LOSS OF OUTPUT ON ALL J3 NONCRITICAL AND J8 CRITICAL OUTPUTS WERE DETECTED ON CORE B DURING EVALUATION TESTING. THE PROBLEM WAS TRACED TO A SHORT CIRCUIT BETWEEN PINS ON CONNECTOR J34 CAUSED BY METALLIC SHAVINGS. THE ASSEMBLY SUPERVISOR WAS NOTIFIED OF THE FAILURE CAUSE AND THE IMPORTANCE OF REWORKING THE MEC WITHOUT LEAVING DEBRIS INSIDE THE UNIT. THIS APPEARS TO BE AN ISOLATED WORKMANSHIP ANOMALY THAT WAS DETECTED DURING FUNCTIONAL TESTING.

CAR AD5358

WHILE PERFORMING ATP, A BIT IN THE RESPONSE DATA WORD (RDW) WAS DETECTED TO BE A "0" WHEN IT SHOULD HAVE BEEN A "1". THE PROBLEM WAS ISOLATED TO A TRANSFORMER WHICH HAD BEEN MISMARKED. A NEW TEST WAS ADDED TO THE TRANSFORMER ASSEMBLY WHERE VERIFICATION WILL BE PERFORMED FOLLOWING THE SILKSCREENING OF THE PIN 1 LOCATOR. A COMPLETE INSPECTION FOR CORRECT MARKING WAS MADE OF ALL TRANSFORMERS IN STOCK.

CAR AD5486

WHILE PERFORMING THE SUPPLIER FUNCTIONAL TEST, SEVERAL BITS IN THE PREFLIGHT BITE RESPONSE DATA WORD (RDW) WERE DETECTED TO BE A "0" WHEN THEY SHOULD HAVE BEEN A "1". AN INTERMITTENT SHIFT WAS NOTED ON A PIN OF U45

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ON MODULE A5 WHEN THE CORRESPONDING INPUT DATA WAS VERIFIED TO BE CORRECT. U45 WAS REPLACED BUT NO ANOMALIES OCCURRED WHEN THE MEC WAS EXTENSIVELY TESTED. POST-MORTEM ANALYSIS OF U45 COULD NOT DUPLICATE THE FAILURE. THIS FAILURE IS CONSIDERED TO BE AN ISOLATED INCIDENT.

CAR AD5754

WHILE PERFORMING ATP, ALL RESPONSE DATA WORDS SHOWED "0'S". THE PROBLEM WAS TRACED TO A RECESSED CONNECTOR PIN WITH A BROKEN LOCKING DEVICE. NEW PINS WERE INSTALLED AND THE MEC WAS RETESTED WITH NO PROBLEMS. THIS FAILURE WAS CONSIDERED TO BE A WORKMANSHIP ANOMALY.

CAR AD6366

DURING THE Z-AXIS ACCEPTANCE VIBRATION TEST, CHANNEL 2 RESPONSE DATA WORD 0 BITS 9-24 READ ALL "0'S". THE FAILURE WAS DETERMINED TO BE CAUSED BY A CRACKED SOLDER JOINT. PRIOR TO FURTHER ANALYSIS BEING PERFORMED, THE JOINT WAS INADVERTENTLY REFLOWED. IN THE FUTURE, FURTHER ANALYSIS WILL BE PERFORMED PRIOR TO REPAIR; THE ENGINEERING AND OPERATION GROUPS AT THE SUPPLIER HAVE BEEN MADE AWARE OF THIS.

CAR AD6426 AND KB1121

DURING MEC POWER UP, THE WRAP TEST FAILED. THE MEC RESPONSE DATA WORD WAS ALL "0'S". BOTH CARS (AD6426 AND KB1121) TRACED THE PROBLEM TO A CRACKED SOLDER JOINT. IN ADDITION, CAR AD6426 DESCRIBED AN OVERSTRESSED IC (U16) WHICH INDICATED ELECTROSTATIC DISCHARGE (ESD) DAMAGE. IT WAS NOT KNOWN WHERE ESD MAY HAVE OCCURRED. THE APPROPRIATE PERSONNEL DEALING WITH ESD SENSITIVE HARDWARE WERE INSTRUCTED IN THE CORRECT PROCEDURES.

CAR AD6443, AD7030, AND KB0683

THERE HAS BEEN THREE OCCURRENCES OF MEC FAILURES WHERE THE PROBLEM WAS TRACED TO A FRACTURED SOLDER JOINT(S) WHERE THE LEAD(S) HAD BEEN SOLDERED UNDER TENSION:

- 1) CAR KB0683 (OV-103) DOCUMENTS THAT FOLLOWING SRB POWERUP, FOUR BITS OF A PREFLIGHT BITE WORD WERE "0'S" WHEN THEY SHOULD BE "1'S". AVAILABLE INFORMATION INDICATES THE BITE CIRCUITRY FOR CORE A WAS NOT OPERATING. THE PROBLEM WAS TRACED TO A FRACTURED SOLDER JOINT WHERE A LEAD HAD BEEN SOLDERED UNDER TENSION.
- 2) CAR AD6443 (MEC SN LMV0010) DOCUMENTS A FAILED DRIVER SWITCH OUTPUT TURN-ON STATE DURING AMBIENT CONFIDENCE TESTING. THE FAILURE OCCURRED IN MODULE I WHERE THREE LEADS HAD SEPARATED FROM THE SOLDER AND LIFTED AWAY FROM THE PAD. FOUR NONFRACTURED JOINTS WERE REFLOWED AND WERE OBSERVED TO LIFT SLIGHTLY FROM THE PAD INDICATING THAT THEY HAD BEEN SOLDERED UNDER TENSION. AN INSPECTION OF THE LEADS DETERMINED THAT THEY HAD BEEN HAND FORMED (AN ACCEPTABLE METHOD BUT IS NOT AS CONSISTENT AS MACHINE FORMED). SIX OF THE SUBJECT IC'S WERE REPLACED WITH NEW PARTS THAT WERE MACHINED FORMED. DURING REMOVAL OF THE IC'S, APPROXIMATELY 80 PERCENT OF THE LEADS WERE ASSESSED TO HAVE BEEN SOLDERED UNDER TENSION.
- 3) CAR AD7030 (MEC SN LMV0011) DESCRIBES THAT WHILE PERFORMING EVALUATION TESTING AT THE SUPPLIER, THE SOLENOID OUTPUT AT J-2 IS 0VDC WHEN IT SHOULD BE 28VDC. MODULE III WAS REMOVED AND INSPECTED AND SEVERAL FRACTURED/SEPARATED SOLDER JOINTS WERE NOTED. THE JOINTS WHEN REFLOWED

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SPRUNG UP, INDICATING THEY HAD BEEN SOLDERED UNDER TENSION. FOLLOWING THIS, ALL MODULES OF THIS MEC WERE REMOVED AND INSPECTED FOR FRACTURES. SEVERAL OTHER JOINTS WERE FOUND TO BE SOLDERED UNDER TENSION. A DETERMINATION WAS MADE THAT THE QUALITY OF SOLDER JOINTS WITHIN MEC HARDWARE ASSEMBLED AFTER 1984 IS POSSIBLY SUSPECT. AS A RESULT, MEC SN LMV0012 WAS RETURNED FROM KSC FOR INSPECTION WHERE ALL OF THE MODULES WITH THE EXCEPTION OF THE POWER SUPPLY'S WERE REMOVED. 126 SOLDER JOINTS WERE REFLOWED AND IT WAS DETERMINED THAT 6 LEADS WERE SOLDERED UNDER TENSION WHILE 4 LEADS WERE OBSERVED TO BE SEPARATED FROM THE SOLDER UPON THE REMOVAL OF THE CONFORMAL COATING. ALL REFLOWED SOLDER JOINTS WERE SUBSEQUENTLY INSPECTED BY QUALITY ASSURANCE AND WERE DETERMINED TO BE OF GOOD QUALITY.

THE SUPPLIER CONDUCTS TRAINING SESSIONS WHICH STRESS THE NEED NOT TO SOLDER LEADS UNDER TENSION.

CAR AD6495

DURING ATP, A NONCRITICAL OUTPUT DID NOT SET AS REQUIRED. THE FAILURE WAS ISOLATED TO A BROKEN TRACE/BOND AT A RESISTOR WHERE SOLDER WAS APPLIED OVER THE DAMAGE PORTION OF THE TRACE IN AN ATTEMPT TO REPAIR THE FRACTURE. THE SOLDER SUBSEQUENTLY CRACKED AT THE SAME LOCATION CREATING AN OPEN CIRCUIT. FOLLOWING NORMAL REPAIR PROCEDURES, A JUMBER WIRE WAS INSTALLED. MANUFACTURING AND SUPERVISION WERE MADE AWARE OF THE NATURE OF THIS FAILURE.

CAR AD6551

WHILE PERFORMING THE Y-AXIS ATP, THE CURRENT AT POWER SUPPLY NUMBER 1 READ HIGH. THE CAUSE WAS ISOLATED TO A CRACKED SOLDER JOINT AT A RESISTOR. CIRCUIT ANALYSIS DISCLOSED A TRANSISTOR OVERSTRESSED BY THE INTERMITTENT "MAKING/BREAKING" OF THE CIRCUIT BY THE CRACKED SOLDER JOINT IT WAS DETERMINED THAT THE SOLDER JOINT WAS INSUFFICIENTLY "WETTED". IN ADDITION, OVERSTRESS ANALYSIS DETERMINED THAT FOUR INDUCTORS AND A TRANSFORMER WERE POTENTIALLY OVERSTRESSED. THE SOLDER JOINT WAS REFLOWED AND THE AFFECTED COMPONENTS WERE REPLACED. MANUFACTURING AND INSPECTION SUPERVISION AT THE SUPPLIER WERE MADE AWARE OF THIS ANOMALY.

CAR KB0603 (OV-102)

FOLLOWING OV-102 VEHICLE POWERDOWN, A BIT IN MEC NO. 2, RIGHT SRB, BUS B, CORE A, WORD 10 (BITE CIRCUITRY) WAS "OFF" WHEN IT SHOULD HAVE BEEN "ON" SUBSEQUENT REPOWERING COULD NOT DUPLICATE THE PROBLEM AND THE PROBLEM COULD NOT REPRODUCED DURING TROUBLESHOOTING. THE MEC WAS RETURNED TO THE SUPPLIER WHO COULD FIND NO PROBLEMS. THE CAR WAS CLOSED OUT AS AN UNEXPLAINED ANOMALY AGAINST THE VEHICLE.

(E) OPERATIONAL USE:

NONE

- APPROVALS -

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EDITORIALLY APPROVED
TECHNICAL APPROVAL

: BNA
: VIA APPROVAL FORM

: J. Kumura 3/31/99
: 96-CIL-021_05-6