

April 19, 1996

CRITICAL ITEMS LIST

PAGE 1

- 1) CIL ITEM : F200-AV-03
- 2) FMEA CODE : F200-AV
- 3) COMPONENT : PROPELLANT VALVE ACTUATOR FAILSAFE SERVO SWITCH CONTROL
- 4) PART NUMBER : RE1493
- 5) SYSTEM/SUBSYSTEM : CONTROLLER/F200-XX
- 6) FAILURE MODE : FAILURE TO MAINTAIN SERVO SWITCH COIL DE-ENERGIZED WHILE IN HYDRAULIC LOCKUP

- 7) PREPARED : SSME RELIABILITY
- 8) APPROVED :
- 9) DATE : 04-19-96
- 10) REVISION/CHANGE : -001/0
- 11) EFFECTIVITY : -05
- 12) HAZARD REFERENCE : SEE LISTINGS BELOW
- 13) DCBD # : MEB-01-385

| PHASE | FAILURE DESCRIPTION/EFFECT | CRITICALITY |
|----------|---|--------------------------|
| N 4-2 | <p>FAILURE TO MAINTAIN ONE SERVO SWITCH DRIVER DE-ENERGIZED IN BOTH DE CHANNELS RESULTS IN A MCF INDICATION AND PNEUMATIC SHUTDOWN VIA POWER DOWN MATRIX. MISSION ABORT.</p> <p>REDUNDANCY SCREENS: CONTROLLER SYSTEM: LIKE REDUNDANCY</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND.</p> <p>B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT.</p> <p>C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p> | 1R HAZARD REF: RE-04N |

F-95

| CCL ITEM: F200-AV-03 | DESIGN | DOCUMENT REF. |
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| ALL CAUSES: OUTPUT ELECTRONICS: ON-OFF VALVE DRIVER FAILURE, FALSE COMMAND PROCESSED TO DRIVER (1) | DUAL REDUNDANT SERVO SWITCH DRIVERS ARE PROVIDED FOR EACH PROPELLANT VALVE (1). A FAILURE IN EITHER CONTROLLER CHANNEL, RESULTING IN INABILITY TO MAINTAIN THE SERVO SWITCH DE-ENERGIZED, RESULTS IN PNEUMATIC SHUTDOWN VIA POWER DOWN MATRIX (2). THE CONTROLLER (WITH SOFTWARE) IS CONFIGURED TO DETECT AND RESPOND PROPERLY TO OUT OF QUALIFICATION LIMIT FAILURES, IMPLEMENT THE APPROPRIATE REDUNDANCY MANAGEMENT RESPONSE, AND COMMAND A SAFE ENGINE STATE WHEN CONTROLLER REDUNDANCY IS LOST (2). HOWEVER, THE CONTROLLER (WITH SOFTWARE) IS NOT CAPABLE OF DETECTING OR RESPONDING TO A FAILURE WHICH RESULTS IN THE LIMITS BEING MONITORED FALLING WITHIN ENGINE REDLINE LIMITS OR WITHIN NORMAL ENGINE OPERATING CONDITIONS (2). | (1) HONEYWELL BLOCK 11 FMEA VOL V OE-F13 (1) DSHG8977A1 (2) CP406R0006 3.1.3:4 3.2.1:6.3 3.2.3:2.3 3.2.3:3 3.2.3:6 3.2.4 |
| ELECTRICAL, MECHANICAL, AND ELECTROMECHANICAL PARTS FOR THE CIRCUITS INVOLVED IN THIS FUNCTION HAVE BEEN SELECTED FROM THE CLASS B OR EQUIVALENT APPROVED PARTS SELECTION LIST (1), QUALITY ASSURANCE AND SCREENING REQUIREMENTS FOR HIGH RELIABILITY MICROCIRCUITS (2), AND THE SPECIFICATION CONTROL DRAWING FOR MICROCIRCUITS, MONOLITHIC SILICON, AND TRANSISTOR-TRANSISTOR LOGIC (TTL) FAMILY OF DEVICES (3). PRIOR TO INSTALLATION ON THE CARD ASSEMBLIES, COMPONENTS ARE SUBJECTED TO A BURN-IN PERIOD WHERE PARTS ARE EXERCISED AT TEMPERATURES IN EXCESS OF NORMAL CONTROLLER OPERATING ENVIRONMENT, BUT LESS THAN COMPONENT MAXIMUM SPECIFIED OPERATING ENVIRONMENT, TO SCREEN FOR INFANT MORTALITY (4). IN ADDITION TO THESE REQUIREMENTS, ALL COMPONENTS ARE DERATED FROM THE MAXIMUM RATING AT OPERATING EXTREMES (5). CLEANLINESS AND ALL PROCESSES USED DURING MANUFACTURE ARE CONTROLLED BY SPECIFICATION REQUIREMENTS (5). | THE CONTROLLER DESIGN MEETS ALL CEI FAIL-OPERATE/FAILSAFE REQUIREMENTS FOR THIS FAILURE MODE (1). REDUNDANT CONTROLLER CHANNEL FUNCTIONS ARE PHYSICALLY SEPARATED WITHIN THE CONTROLLER HOUSING (2). CIRCUITS ARE DESIGNED TO PREVENT BRIDGING (2), ALL PCB PARTS ARE REQUIRED TO HAVE CONFORMAL COATING, AND INTERNAL WIRING IS INSULATED TO PREVENT SHORT CIRCUITS FROM CONDUCTIVE CONTAMINATION (3). ALL ELECTRICAL COMPONENTS ARE CONTAINED WITHIN THE CASE STRUCTURE WHICH IS PRESSURIZED WITH A POSITIVE PRESSURE INERT GAS BACKFILL TO PREVENT CONTAMINATION (2). WHERE APPLICABLE, ELECTROMAGNETIC INTERFERENCE SHIELDING IS PROVIDED AND CIRCUIT INTERCONNECTS USE TWISTED PAIR WIRING (2). ALL CIRCUIT CARDS ARE KEYED TO THEIR RESPECTIVE CONNECTION LOCATIONS TO PRECLUDE IMPROPER INSTALLATION (2). RAMP CLAMPS ARE UTILIZED TO PRECLUDE VIBRATION INDUCED CARD FAILURES (2). DESIGN OF CIRCUIT CARDS AND DETERMINATION OF COPPER PATH TRACE SPACING, WEIGHT, AND WIDTH IS CONTROLLED BY SPECIFICATION (2). EACH UNIT (PRODUCTION AND RECYCLE) IS REQUIRED TO PASS A FUNCTIONAL ACCEPTANCE TEST UNDER ENVIRONMENTAL CONDITIONS BEYOND THOSE SEEN DURING NORMAL FIELD OPERATION WITHOUT DEGRADATION OF HARDWARE LIFE EXPECTANCY (2). A WORST CASE CIRCUIT ANALYSIS WAS PERFORMED TO VERIFY NOMINAL OPERATION AT SPECIFICATION LIMITS (4). AN ANALYSIS WAS PERFORMED BY HONEYWELL TO ASSURE NO SINGLE POINT COMPONENT FAILURES ARE INHERENT TO THE CONTROLLER DESIGN (5). | (1) B5MD3928, B5MD3929 (2) B5M02704 (3) B5M03766 (4) B5M03876 (5) DSHG8977A1 (1) CP320R0003B (2) DSHG8977A1 (3) B5M03928 (4) ES24472-01 (5) HONEYWELL BLOCK 11 FMEA VOL I |

| CIL ITEM: F200-AV-03 | | DESIGN | DOCUMENT REF. |
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| DESIGN QUALIFICATION TESTING OF THE CONTROLLER ASSEMBLY HAS BEEN PERFORMED INCLUDING: FAULT INSERTION TESTING (1), ASSEMBLY THERMAL CYCLING (2), CASE AND ASSEMBLY VIBRATION TESTING (3), ELECTROMAGNETIC INTERFERENCE AND SUSCEPTIBILITY TESTING (4), ACOUSTICAL NOISE TESTING (5), CASE ULTIMATE PRESSURE TESTING (6), AND ASSEMBLY BREAK OPEN INSPECTION (7). | | | (1) TR34079282 TR34080202 TR34080258 TR34080259 (2) TR34080203 TR34080207 (3) TR34080204 TR34080206 TR34087499 (4) TR34080209 (5) TR34080210 (6) TR34085021 (7), TR34085022 |
| CIL ITEM: F200-AV-03 | | INSPECTION AND TEST | |
| POSSIBLE CAUSES | SIGNIFICANT CHARACTERISTICS | INSPECTION(S)/TEST(S) | DOCUMENT REF. |
| ALL CAUSES: | RE1493 - CONTROLLER | | RE1493 |
| | ASSEMBLY INTEGRITY | CLEANLINESS REQUIREMENTS ARE VERIFIED PER SPECIFICATION DURING MANUFACTURING OF THE CONTROLLER ASSEMBLY. | RE1493 |
| | | ENVIRONMENT CONTROLS (TEMPERATURE, HUMIDITY) ARE ENFORCED DURING ASSEMBLY AND TESTING PER SPECIFICATION REQUIREMENTS. | DSHG8977A1 |
| | | TO PREVENT COMPONENT DAMAGE, STATIC ELECTRICAL DISCHARGE POTENTIAL IS CONTROLLED DURING MANUFACTURING PER SPECIFICATION REQUIREMENTS. | DSHG8977A1 |
| | MATERIAL INTEGRITY | MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS. | RC1493 |

| CIL ITEM: F200-AV-03 | | INSPECTION AND TEST | |
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| POSSIBLE CAUSES | SIGNIFICANT CHARACTERISTICS | INSPECTION(S)/TEST(S) | DOCUMENT REF. |
| | | PROTECTIVE FINISHES AND MATERIAL SELECTION TO PREVENT DETRIMENTAL EFFECTS FROM ENVIRONMENTAL EXPOSURE, STRESS CORROSION, AND ELECTROLYTIC CORROSION ARE VERIFIED PER SPECIFICATION REQUIREMENTS. | RC1493 MSFC-SPEC-250 |
| | | FLAMMABILITY REQUIREMENTS ARE VERIFIED PER SPECIFICATION REQUIREMENTS. | RC1493 |
| | INTEGRITY OF ELECTRONICS | THE FOLLOWING PROCESSES ARE VERIFIED PER SPECIFICATION DURING MANUFACTURING OF THE CARD ASSEMBLIES: <ul style="list-style-type: none"> - CONSTRUCTION OF PRINTED CIRCUIT BOARDS. - INSTALLATION OF TERMINALS. - PLASTICS AND ELASTOMERS FOR ELECTRONIC ENCAPSULATION. - SOLDERED ELECTRICAL CONNECTIONS. - POST-SOLDERING INSPECTION FREE OF SPLATTER AND CONTAMINATION. - ELECTRICAL BONDING. - COMPONENT LEAD AND INTERCONNECTION MATERIAL SELECTION. - FREE OF CONTAMINATION AFTER CONFORMAL COATING. | RL10005 RL10007 RL10008 RL10009 RL10009 RC1493 DSHC392B RC1493 |
| | WELD INTEGRITY | ALL WELDS ARE VERIFIED TO DRAWING AND SPECIFICATION REQUIREMENTS. | RL10011 |
| | PRE-CLOSEOUT TESTING AND INSPECTION | THE FOLLOWING TESTS ARE PERFORMED AT THE CARD/COMPONENT LEVEL DURING MANUFACTURING: <ul style="list-style-type: none"> - PARTICAL IMPACT NOISE DETECTION (PIND) TEST ON HYBRID MICROCIRCUITS AND CAVITY TYPE DEVICES. - ULTRASONIC SCAN TEST FOR DELAMINATION CERAMIC ON CAPACITORS (CKR05 AND CKR06). - BURN-IN PERIOD FOR ELECTRICAL PARTS. - INSULATION RESISTANCE AND CONTINUITY TEST. - DIELECTRIC WITHSTANDING VOLTAGE. - FUNCTIONAL TEST. - X-RAY OF CONTROLLER INTERNAL CABLES AND WIRES. | DSHG8977A1 DSHG8977A1 DSHC392B DSHG8977A1 DSHG8977A1 DSHG8977A1 DSHG8977A1 |

F-98

| CIL ITEM: F200-AV-03 | | INSPECTION AND TEST | |
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| POSSIBLE CAUSES | SIGNIFICANT CHARACTERISTICS | INSPECTION(S)/TEST(S) | DOCUMENT REF. |
| | | <p>THE FOLLOWING INSPECTIONS ARE PERFORMED ON THE COMPLETED ASSEMBLY PRIOR TO FINAL CLOSURE:</p> <ul style="list-style-type: none"> - INTERNAL AND EXTERNAL CLEANLINESS. - CARD DIMENSIONS ARE VERIFIED AT CARD ASSEMBLY. - CHASSIS CAVITY INSPECTION FOR CONTAMINATION. - ELECTRICAL INTERFACE CONNECTORS. - CARD INSTALLATION AND CONFIGURATION AUDIT. - CONFORMAL COATING OF EEE PARTS. | <p>RC1493 DSHG8977A1 RC1493 RC1493 DSHG8977A1 85M03928</p> |
| | ACCEPTANCE TESTS | <p>THE FOLLOWING TESTS ARE PERFORMED BY HONEYWELL DURING ACCEPTANCE TESTING:</p> <ul style="list-style-type: none"> - HERMETIC SEAL AND PRESSURIZATION PORT LEAK TEST. - FUNCTIONAL TEST INCLUDING: <ul style="list-style-type: none"> - OUTPUT INTERFACE, - CHECKOUT, - OPERATION, - CONTROLLER CHECKOUT. - HIGH TEMPERATURE OPERATION. - LOW TEMPERATURE OPERATION. - VIBRATION TESTING. - FINAL FUNCTIONAL TEST. | <p>RC1493 RC1493 RC1493 RC1493 RC1493 RC1493 RC1493 RC1493 RC1493</p> |
| | NOT FIRE ACCEPTANCE TESTING (GREEN RUN) | CONTROLLER OPERATION IS VERIFIED THROUGH ENGINE NOT FIRE ACCEPTANCE TESTING. | RL00461 |
| | HERMETIC SEAL INTEGRITY | INTERNAL PRESSURE IS MONITORED DURING CONTROLLER OPERATION. | OMRSD V41AK0.040 |
| | FLIGHT FLOW TESTING | <p>THE FOLLOWING TESTS ARE PERFORMED DURING FLIGHT FLOW VEHICLE PROCESSING AND AFTER ANY MAINTENANCE OR REPLACEMENT:</p> <ul style="list-style-type: none"> - CONTROLLER CHECKOUT. - ACTUATOR CHECKOUT. - FLIGHT READINESS TEST. - SELF-TEST. | <p>OMRSD V41AK0.035 OMRSD V41AS0.010 OMRSD V41AS0.030-A CP40680008</p> |

| CCL ITEM: F200-AV-03 | | INSPECTION AND TEST | |
|---|-----------------------------|---|---|
| POSSIBLE CAUSES | SIGNIFICANT CHARACTERISTICS | INSPECTION(S)/TEST(S) | DOCUMENT REF. |
| | PRE-FLIGHT CHECKOUT | THE FOLLOWING TESTS ARE PERFORMED DURING LAUNCH COUNTDOWN: - PRE-CRYD LOADING CONTROLLER CHECKOUT. - SELF-TEST. CONTROLLER OPERATION IS VERIFIED BY THE GROUND LAUNCH SEQUENCER PRIOR TO ENGINE START BY ACCEPTANCE OF COMMANDS PURGE SEQUENCE 4, POWER LEVEL, AND START ENABLE. | OMRSD SOOFAD.213 CP406R0008 LAUNCH ADMIT CRITERIA 86E-4-1126 |
| | CONTINUOUS SELF-TEST | BITE TEST IS PERFORMED EVERY MAJOR CYCLE TO VERIFY HARDWARE INTEGRITY. (LAST TEST) | CP406R0008 |
| FAILURE HISTORY: COMPREHENSIVE FAILURE HISTORY DATA IS MAINTAINED IN THE PROBLEM REPORTING DATABASE (PRAMS/PRACA). REFERENCE: NASA LETTER SA21/88/308 AND ROCKETDYNE LETTER 88RC09761. | | | |

OPERATIONAL USE: NOT APPLICABLE.