

April 19, 1996

CRITICAL ITEMS LIST

PAGE 1

1) CIL ITEM : F200-AX-02  
 2) FMEA CODE : F200-AX  
 3) COMPONENT : PROPELLANT VALVE ACTUATOR POSITION CONTROL  
 4) PART NUMBER : RE1493  
 5) SYSTEM/SUBSYSTEM : CONTROLLER/F200-KX  
 6) FAILURE MODE : FAILURE OF THE SERVOACTUATOR ERROR INDICATION INTERRUPT MONITOR SYSTEM

7) PREPARED : SSRE RELIABILITY  
 8) APPROVED :  
 9) DATE : 04-19-96  
 10) REVISION/CHANGE : -001/0  
 11) EFFECTIVITY : -05  
 12) HAZARD REFERENCE : SEE LISTINGS BELOW  
 13) CCBD # : ME3-01 3285

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
P	<p>FAILURE OF ACTUATOR MONITORING SYSTEM TO THE SELFTEST LIMIT RESULTS IN LOSS OF SEII PROTECTION. LOSS OF VEHICLE DUE TO OPEN AIR DETONATION OR FIRE MAY RESULT IF NFV OPENS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: CONTROLLER SYSTEM - ENGINE SYSTEM; UNLIKE REDUNDANCY</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND.                      B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT.                      C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R                      HAZARD REF: ME-A1P,                      ME-B2P</p>
M	<p>FAILURE OF ACTUATOR MONITORING SYSTEM TO THE SELFTEST LIMIT RESULTS IN LOSS OF SEII PROTECTION. FAILURE OF PROPELLANT VALVE POSITION CONTROL CAUSES VIOLATION OF REDLINE LIMITS. CONTROLLER ISSUES SLE INDICATION AND INITIATES HYDRAULIC ENGINE SHUTDOWN. CONTAINED ENGINE DAMAGE. MISSION ABORT.</p> <p>REDUNDANCY SCREENS: CONTROLLER SYSTEM - ENGINE SYSTEM; UNLIKE REDUNDANCY</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND.                      B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT.                      C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R                      HAZARD REF: ME-B2N,                      ME-B6N,                      ME-B7N,                      ME-C3N</p>
C	<p>FAILURE OF ACTUATOR MONITORING SYSTEM TO THE SELF TEST LIMIT RESULTS IN LOSS OF SEII PROTECTION. FAILURE OF PROPELLANT VALVE POSITION CONTROL CAUSES UNCONTAINED ENGINE DAMAGE, FIRE AND EXPLOSION. LOSS OF VEHICLE.</p> <p>REDUNDANCY SCREENS: CONTROLLER SYSTEM - ENGINE SYSTEM; UNLIKE REDUNDANCY</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND.                      B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT.                      C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R                      HAZARD REF: ME-A1R,                      ME-B4A,C,                      ME-B6A,C,                      ME-B7A,C,                      ME-C3A,C,                      ME-D1A,C</p>

E-113

CIL ITEM: F200-AX-02

## DESIGN

## DOCUMENT REF.

ALL CAUSES: SERVOACTUATOR MODEL MONITOR CIRCUIT. (1)

EACH PROPELLANT VALVE HAS REDUNDANT CONTROL FROM EACH CONTROLLER CHANNEL (1). A FAILURE IN BOTH CONTROLLER CHANNELS (MULTIPLE FAILURE), RESULTING IN LOSS OF FUNCTION, RESULTS IN HYDRAULIC LOCKUP (2). THE CONTROLLER (WITH SOFTWARE) IS CONFIGURED TO DETECT AND RESPOND PROPERLY TO OUT OF LIMIT FAILURES, IMPLEMENT THE APPROPRIATE REDUNDANCY MANAGEMENT RESPONSE, AND COMMAND A SAFE ENGINE STATE (2). HOWEVER, THE CONTROLLER (WITH SOFTWARE) IS NOT CAPABLE OF DETECTING OR RESPONDING TO A FAILURE WHICH RESULTS IN THE LOSS OF CONTROLLER SELFTEST RESPONSE WITHIN NORMAL SELFTEST MARGINS FOR THE SEI MONITORING SYSTEM.

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 SUBJECT 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 EEE 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 KEYS 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) HONEYWELL BLOCK 11  
FNEA VOL V DE-F20

(1) DSHG8977A1  
(2) CP406R0008  
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

(1) BSM03928,  
BSM03929  
(2) BSM02704  
(3) BSM03766  
(4) BSM03876  
(5) DSHG8977A1

(1) CP320R0003H  
(2) DSHG8977A1  
(3) BSM03928  
(4) ES26472-01  
(5) HONEYWELL BLOCK 11  
FNEA VOL 1

CIL ITEM: F200-AX-02		DESIGN	DOCUMENT REF.
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 TR34080250 TR34080250 (2) TR34080203 TR34080207 (3) TR34080204 TR34080205 TR34080206 TR34087499 (4) TR34080209 (5) TR34080210 (6) TR34085021 (7) TR34085022
CIL ITEM: F200-AM-02		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. ENVIRONMENT CONTROLS (TEMPERATURE, HUMIDITY) ARE ENFORCED DURING ASSEMBLY AND TESTING PER SPECIFICATION REQUIREMENTS. TO PREVENT COMPONENT DAMAGE, STATIC ELECTRICAL DISCHARGE POTENTIAL IS CONTROLLED DURING MANUFACTURING PER SPECIFICATION REQUIREMENTS.	RC1493 DSHG8977A1 DSHG8977A1
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RC1493

CIL ITEM: F200-AM-02		INSPECTION AND TEST	
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 NSFC-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:  - 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 BSM03928 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:  - PARTIAL IMPACT NOISE DETECTION (PIND) TEST ON HYBRID MICROCIRCUITS AND CAVITY TYPE DEVICES. - ULTRASONIC SCAN TEST FOR DELAMINATION CERAMIC ON CAPACITORS (C0R05 AND C0R06). - 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 BSM03928 DSHG8977A1 DSHG8977A1 DSHG8977A1 DSHG8977A1

CCL ITEM: F200-AX-02		INSPECTION AND TEST	
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"> <li>- INTERNAL AND EXTERNAL CLEANLINESS.</li> <li>- CARD DIMENSIONS ARE VERIFIED AT CARD ASSEMBLY.</li> <li>- CHASSIS CAVITY INSPECTION FOR CONTAMINATION.</li> <li>- ELECTRICAL INTERFACE CONNECTORS.</li> <li>- CARD INSTALLATION AND CONFIGURATION AUDIT.</li> <li>- CONFORMAL COATING OF EEE PARTS.</li> </ul>	<p>RC1493 DSHG8977A1 RC1493 RC1493 DSHG8977A1 BSM03928</p>
	ACCEPTANCE TESTS	<p>THE FOLLOWING TESTS ARE PERFORMED BY HONEYWELL DURING ACCEPTANCE TESTING:</p> <ul style="list-style-type: none"> <li>- HERMETIC SEAL AND PRESSURIZATION PORT LEAK TEST.</li> <li>- FUNCTIONAL TEST INCLUDING: <ul style="list-style-type: none"> <li>- OUTPUT INTERFACE,</li> <li>- CHECKOUT,</li> <li>- OPERATION,</li> <li>- CONTROLLER CHECKOUT.</li> </ul> </li> <li>- HIGH TEMPERATURE OPERATION.</li> <li>- LOW TEMPERATURE OPERATION.</li> <li>- VIBRATION TESTING.</li> <li>- FINAL FUNCTIONAL TEST.</li> </ul>	<p>RC1493 RC1493 RC1493 RC1493 RC1493 RC1493 RC1493 RC1493 RC1493</p>
	HOT FIRE ACCEPTANCE TESTING (GREEN RUN)	CONTROLLER OPERATION IS VERIFIED THROUGH ENGINE HOT FIRE ACCEPTANCE TESTING.	RL00461
	HERMETIC SEAL INTEGRITY	INTERNAL PRESSURE IS MONITORED DURING CONTROLLER OPERATION.	CMRSD V41AND.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"> <li>- CONTROLLER CHECKOUT.</li> <li>- ACTUATOR CHECKOUT.</li> <li>- FLIGHT READINESS TEST.</li> <li>- SELF-TEST.</li> </ul>	<p>CMRSD V41AND.035 CMRSD V41ASD.010 CMRSD V41ASD.030-A CP406R0008</p>

CIL ITEM: F200-AX-02		INSPECTION AND TEST	
POSSIBLE CAUSES	SIGNIFICANT CHARACTERISTICS	INSPECTION(S)/TEST(S)	DOCUMENT REF.
	PRE-FLIGHT CHECKOUT	<p>THE FOLLOWING TESTS ARE PERFORMED DURING LAUNCH COUNTDOWN:</p> <ul style="list-style-type: none"> <li>- PRE-CRYO LOADING CONTROLLER CHECKOUT.</li> <li>- SELF-TEST.</li> </ul> <p>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.</p>	<p>OMRSD S00FA0.213 CP406R0008</p> <p>LAUNCH COMMIT CRITERIA B&amp;E-4-1126</p>
	CONTINUOUS SELF-TEST	BITE TEST IS PERFORMED EVERY MAJOR CYCLE TO VERIFY HARDWARE INTEGRITY. (LAST TEST)	CP406R0008
<p>FAILURE HISTORY: COMPREHENSIVE FAILURE HISTORY DATA IS MAINTAINED IN THE PROBLEM REPORTING DATABASE (PRMS/PRCA). REFERENCE: NASA LETTER S421/88/308 AND ROCKETDYNE LETTER 88RC09761.</p>			

OPERATIONAL USE: NOT APPLICABLE.