

- 1) CIL ITEM : F200-AJ-01
- 2) FMEA CODE : F200-AJ
- 3) COMPONENT : NPOTP INSL PURGE PRESSURE SENSOR INTERFACE P15
- 4) PART NUMBER : RE1493
- 5) SYSTEM/SUBSYSTEM : CONTROLLER/F200-XX
- 6) FAILURE MODE : FAILURE OF THE NPOTP INSL PURGE PRESSURE SENSOR INTERFACE

- 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) CCBD # : ME3-013285

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
P 4-3	<p>FAILURE OF BOTH QUALIFIED SENSOR INTERFACES OR REMAINING QUALIFIED SENSOR INTERFACE WITHIN REDLINE LIMITS RESULTS IN LOSS OF ENGINE START INHIBIT PROTECTION. LOSS OF VEHICLE DURING START DUE TO NPOTP FIRE MAY RESULT IF NPOTP INSL PURGE FAILS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: CONTROLLER SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</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-C15,H</p>
S 4-4	<p>FAILURE OF ONE OR BOTH QUALIFIED SENSOR INTERFACES OR REMAINING QUALIFIED SENSOR INTERFACE WITHIN REDLINE LIMITS RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO NPOTP FIRE MAY RESULT IF NPOTP INSL PURGE FAILS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: CONTROLLER SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</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-C15,H</p>
M 4-2	<p>FAILURE OF BOTH SENSOR INTERFACES OUTSIDE QUALIFICATION LIMITS RESULTS IN DISQUALIFICATION OF BOTH SENSORS. LOSS OF VEHICLE DUE TO NPOTP FIRE MAY RESULT IF NPOTP INSL PURGE FAILS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: CONTROLLER SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: ME-C15,H</p>

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F200-AJ-01

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
M 4-3	<p>FAILURE OF BOTH QUALIFIED SENSOR INTERFACES OR REMAINING QUALIFIED SENSOR INTERFACE OUTSIDE REDLINE LIMITS RESULTS IN A SLE INDICATION AND CONTROLLER INITIATED SHUTDOWN. (THE EMERGENCY SHUTDOWN SOLENOID IS DE-ENERGIZED PROVIDING "BACKDOOR" INSL PURGE). 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. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	1R HAZARD REF: ME-G4H
B 4-4	<p>FAILURE OF ONE OR BOTH SENSOR INTERFACE(S) OR REMAINING QUALIFIED SENSOR INTERFACE WITHIN REDLINE LIMITS RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO NPOTP FIRE MAY RESULT IF NPOTP INSL PURGE FAILS 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>	1R HAZARD REF: ME-C15,M
C 4-2	<p>FAILURE OF ONE OR BOTH QUALIFIED SENSOR INTERFACE(S) WITHIN MONITORING LIMITS RESULTS IN LOSS OF MONITORING PROTECTION. LOSS OF VEHICLE DUE TO NPOTP FIRE MAY RESULT IF NPOTP INSL PURGE FAILS 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>	1R HAZARD REF: ME-C1A,C

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CIL ITEM: F200-AJ-D1	DESIGN	DOCUMENT REF.
ALL CAUSES: INPUT ELECTRONICS: OPEN OR SHORT CIRCUIT OF THE SENSOR INTERFACE (1)	THE HPOTP INTERMEDIATE SEAL PRESSURE SENSOR INTERFACES ARE REDUNDANT (1). A FAILURE MUST OCCUR IN EACH CONTROLLER CHANNEL (MULTIPLE FAILURE) TO CAUSE LOSS OF FUNCTION (2). THE CONTROLLER (WITH SOFTWARE) IS CONFIGURED TO DETECT AND RESPOND PROPERLY TO OUT OF QUALIFICATION LIMIT FAILURE, 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 FAILING WITHIN ENGINE REDLINE LIMITS OR WITHIN NORMAL ENGINE OPERATING CONDITIONS (2).	<p>(1) HONEYWELL BLOCK II FMEA VOL IV TE-F4</p> <p>(1) DSHG8977A1 (2) CP406R0006 3.1.3:3 3.2.1:6.2 3.2.3:2.3 3.2.3:3 3.2.3:4 3.2.3:5 3.2.4</p>
ELECTRICAL, MECHANICAL, AND ELECTROMECHANICAL PARTS FOR THE CIRCUITS INVOLVED IN THIS FUNCTION HAVE BEEN SELECTED FROM THE CLASS S 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 CEJ 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 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).	<p>(1) 85M03928, 85M03929 (2) 85M02704 (3) 85M03766 (4) 85M03876 (5) DSHG8977A1</p> <p>(1) CP320R0003H (2) DSHG8977A1 (3) 85M03928 (4) ES26472-01 (5) HONEYWELL BLOCK II FMEA VOL I</p>

CIL ITEM: F200-AJ-D1		INSPECTION AND TEST	
POSSIBLE CAUSES	SIGNIFICANT CHARACTERISTICS	INSPECTION(S)/TEST(S)	DOCUMENT REF.
F-41	INTEGRITY OF ELECTRONICS	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
		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 85M03928 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"> - PARTIAL IMPACT NOISE DETECTION (PIND) TEST ON HYBRID MICROCIRCUITS AND CAVITY TYPE DEVICES. - ULTRASONIC SCAN TEST FOR DELAMINATION CERAMIC ON CAPACITORS (CXR05 AND CXR06). - 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 85M03928 DSHG8977A1 DSHG8977A1 DSHG8977A1 DSHG8977A1 DSHG8977A1	

C/L ITEM: F200-AJ-01		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"> - 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 V41A90.040
	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. - SENSOR CHECKOUT. - FLIGHT READINESS TEST. - SELF-TEST. 	<p>OMRSD V41A90.035 OMRSD V41A90.010 OMRSD V41A90.030-A CP40680008</p>

CTL ITEM: F200-AJ-01		INSPECTION AND TEST	
POSSIBLE CAUSES	SIGNIFICANT CHARACTERISTICS	INSPECTION(S)/TEST(S)	DOCUMENT REF.
	PRE-FLIGHT CHECKOUT	THE FOLLOWING TESTS ARE PERFORMED DURING LAUNCH COUNTDOWN (LAST TEST): - PRE-CRYO LOADING CHECKOUT INCLUDING CONTROLLER AND SENSORS CHECKOUT. - SELF-TEST.	OMRSD 800FAD.213 CP406R0008
FAILURE HISTORY: COMPREHENSIVE FAILURE HISTORY DATA IS MAINTAINED IN THE PROBLEM REPORTING DATABASE (PRMS/PRCA). REFERENCE: NASA LETTER SA21/88/308 AND ROCKETDYNE LETTER B0RC09761.			

OPERATIONAL USE: NOT APPLICABLE.