

**SSME FMEA/CIL
REDUNDANCY SCREEN**

Component Group: Pneumatic Controls
 CIL Item: C200-09
 Component: Pneumatic Control Assembly
 Part Number: R0019450
 Failure Mode: Insufficient or no helium purge flow.

Prepared: P. Lowmora
 Approved: T. Nguyen
 Approval Date: 6/2/99
 Change #: 1
 Directive #: CCBD ME3-01-5213
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Phase	Failure / Effect Description	Criticality Hazard Reference
P 4.1	<p>Pneumatic control package fails to provide helium pressurant flow to HPOTP intermediate seal purge. Insufficient purge fails to maintain inerting purge barrier. Controller monitors HPOTP intermediate seal purge pressure sensor and detects out-of-limit condition. Engine ready is inhibited. Launch delay. Loss of vehicle due to HPOTP fire may result if failure to provide HPOTP IMSL purge is not detected.</p> <p>Redundancy Screens: PNEUMATIC SYSTEM - SENSOR SYSTEM; UNLIKE REDUNDANCY</p> <p>A: Pass - Redundant hardware items are capable of checkout during normal ground turnaround. B: Pass - Loss of a redundant hardware items is detectable during flight. C: Fail - Loss of redundant hardware items could result from a single credible event.</p>	1R ME-C15
S 4.1	<p>Controller monitors intermediate seal purge pressure. Controller detects out-of-limit condition caused by loss or reduction of purge. Controller de-energizes emergency shutdown solenoid enabling EMSD intermediate seal purge through purge sequence PAV. Mission scrub. Loss of vehicle due to HPOTP fire may result if failure to provide HPOTP IMSL purge is not detected.</p> <p>Redundancy Screens: PNEUMATIC SYSTEM - SENSOR SYSTEM; UNLIKE REDUNDANCY</p> <p>A: Pass - Redundant hardware items are capable of checkout during normal ground turnaround. B: Pass - Loss of a redundant hardware items is detectable during flight. C: Fail - Loss of redundant hardware items could result from a single credible event.</p>	1R ME-C15
M 4.1	<p>Controller monitors intermediate seal purge pressure. Controller detects out-of-limit condition caused by loss or reduction of purge. Controller de-energizes emergency shutdown solenoid enabling EMSD intermediate seal purge through purge sequence PAV. Mission abort. Loss of vehicle due to HPOTP fire may result if failure to provide HPOTP IMSL purge is not detected.</p> <p>Redundancy Screens: PNEUMATIC SYSTEM - SENSOR SYSTEM; UNLIKE REDUNDANCY</p> <p>A: Pass - Redundant hardware items are capable of checkout during normal ground turnaround. B: Pass - Loss of a redundant hardware items is detectable during flight. C: Fail - Loss of redundant hardware items could result from a single credible event.</p>	1R ME-C15
C 4.1	<p>Controller monitors intermediate seal purge pressure. Controller detects out-of-limit condition caused by loss or reduction of purge. Controller de-energizes emergency shutdown solenoid enabling backdoor intermediate seal purge. Loss of vehicle due to HPOTP fire may result if failure to provide HPOTP IMSL purge is not detected.</p> <p>Redundancy Screens: PNEUMATIC SYSTEM - SENSOR SYSTEM; UNLIKE REDUNDANCY</p> <p>A: Pass - Redundant hardware items are capable of checkout during normal ground turnaround. B: Pass - Loss of a redundant hardware items is detectable during flight. C: Fail - Loss of redundant hardware items could result from a single credible event.</p>	1R ME-C1C, ME-C1A

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SSME A/CIL
DESIGN

Component Group: Pneumatic Controls
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Design / Document Reference

FAILURE CAUSE: A: Dual open or short in HPOTP intermediate seal purge solenoid valve.

ELECTRICAL AND ELECTROMECHANICAL PARTS FOR THE CIRCUITS INVOLVED IN THIS FUNCTION HAVE BEEN SELECTED FROM THE CLASS S OR EQUIVALENT PARTS SELECTION AND CONTROL REQUIREMENTS FOR THE SPACE SHUTTLE ENGINES (1). THE SOLENOID COILS ARE WOUND ON SEPARATE SPOOLS (2). LEADWIRE PAIRS (3) ARE SEPARATELY ROUTED TO REMOTE ELECTRICAL RECEPTACLES. THE SOLENOID IS POTTED (4) TO PREVENT WIRE MOVEMENT OR MOISTURE PROBLEMS. DUAL COILS ARE PROVIDED TO PRECLUDE SINGLE POINT ELECTRICAL FAILURES. SOLENOID ELECTRICAL CONNECTORS ARE DESIGNED TO SEAL AGAINST MOISTURE/CONTAMINATION (5). SOLENOID RECEPTACLE PINS ARE NICKEL UNDERPLATED AND GOLD OVERPLATED TO PREVENT CORROSION (6). THE PNEUMATIC CONTROL ASSEMBLY HAS SUCCESSFULLY PASSED DESIGN VERIFICATION TESTING (7) WHICH INCLUDED PRESSURE TESTING (8), PRESSURE CYCLING (9), AND VIBRATION TESTING (10). THE HPOTP INTERMEDIATE SEAL PURGE PRESSURE REDLINE WILL LIMIT CRITICALITY OF FAILURE TO ENGINE SHUTDOWN. THE CONTROLLER MONITOR SYSTEM IS COMPRISED OF REDUNDANT SENSOR ELECTRONICS, REDUNDANT HARNESSSES, AND REDUNDANT CONTROLLER CHANNELS (11)

(1) 85M03928; (2) RS010348; (3) 40M39513; (4) RL00083; (5) RS010341; (6) MSFC-SPEC-522, MSFC-SPEC-250; (7) DVS-SSME-510; (8) RSS-510-46; (9) RSS-510-51; (10) RSS-510-50; (11) CP406R0002 PT 1 3.2.3.5.2

**SSME FMEA/CIL
INSPECTION AND TEST**

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	PNEUMATIC CONTROL SOLENOID RECEPTACLE		RS010341 RES1231
	INTEGRITY OF ELECTRONICS AND SOLENOID RECEPTACLE PINS	<p>THE FOLLOWING ELECTRICAL INSPECTIONS ARE PERFORMED DURING THE MANUFACTURE OF THE COIL/SOLENOID:</p> <ul style="list-style-type: none"> - SOLDERING OF THE ELECTRICAL CONNECTIONS AND COIL LEADS. - POTTING OF THE ELECTRICAL CONNECTIONS IN THE CONNECTOR. - PLATING OF RECEPTACLE PINS IS INSPECTED PER DRAWING REQUIREMENTS. <p>THE FOLLOWING ELECTRICAL TESTS ARE PERFORMED ON THE COIL/SOLENOID DURING ACCEPTANCE TESTING AND ASSEMBLY:</p> <ul style="list-style-type: none"> - INSULATION RESISTANCE BETWEEN PINS AND COILS IS VERIFIED TO BE WITHIN SPECIFICATION. - EACH COIL INTERNAL RESISTANCE IS VERIFIED TO BE WITHIN ACCEPTABLE RANGES. - BY TESTING EACH INDIVIDUAL COIL, THE PULL-IN AND DROP-OUT CURRENT REQUIREMENTS ARE VERIFIED TO BE WITHIN SPECIFICATION. THE TEST IS REPEATED WITH BOTH COILS ENERGIZED SIMULTANEOUSLY. - ACTUATION AND DE-ACTUATION TIMING IS TESTED AND VERIFIED TO BE WITHIN ACCEPTABLE RANGES. 	RL10009 RL10009 RES1231 RL00226 RL00226 RL00226 RL00226
	PNEUMATIC CONTROL ASSEMBLY		R0019450
	ASSEMBLY TESTING	<p>THE FOLLOWING TESTS ARE PERFORMED DURING ASSEMBLY AND FUNCTIONAL TESTING OF THE PNEUMATIC CONTROL ASSEMBLY:</p> <ul style="list-style-type: none"> - INSULATION RESISTANCE IS INSPECTED. - SOLENOID VALVE ACTUATION IS VERIFIED - ASSEMBLY OPERATION IS VERIFIED BY TESTING EACH FUNCTION OF THE PNEUMATIC CONTROL ASSEMBLY 	RL00344 RL00344 RL00344
	HOT-FIRE ACCEPTANCE TESTING (GREEN RUN)	PNEUMATIC CONTROL ASSEMBLY OPERATION IS VERIFIED THROUGH HOT-FIRE ACCEPTANCE TESTING.	RL00461
	PRE-FLIGHT CHECKOUT	<p>HPOTP INTERMEDIATE SEAL PURGE SOLENOID OPERATION IS VERIFIED DURING SSME ELECTRICAL CHECKOUT PRIOR TO FLIGHT OR AFTER ANY REPLACEMENT OF RELATED COMPONENTS BY PERFORMING THE FOLLOWING OMRSD REQUIREMENTS:</p> <ul style="list-style-type: none"> - FLIGHT READINESS TEST INCLUDING PNEUMATIC SHUTDOWN. - FLIGHT READINESS TESTS AND VALVE CYCLE VERIFICATION - PRF-CRYO LOADING. <p>- PURGE SEQUENCE NUMBER 4. (LAST TEST)</p>	OMRSD V41AS0 030 OMRSD S00FAC.211 OMRSD S00FAC.213 OMRSD S0CFMC.250

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
Failure History:	Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA) Reference: NASA letter SA21/BR308 and Rocketdyne letter 88RC09761.		
Operational Use:	Not Applicable.		