

**SSME FMEA/CIL
REDUNDANCY SCREEN**

Component Group: Pneumatic Controls
 CIL Item: C200-16
 Component: Pneumatic Control Assembly
 Part Number: R8019450
 Failure Mode: Failure to contain helium.

Prepared: P. Lowrmore
 Approved: T. Nguyen
 Approval Date: 6/2/99
 Change #: 1
 Directive #: CCBD ME3-01-6213
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Phase	Failure / Effect Description	Criticality Hazard Reference
P 4.1	<p>Loss of helium pressurant to operating system. Controller monitors HPOTP intermediate seal purge pressure sensor and detects out-of-limit condition. Next purge sequence inhibited. Launch delay. Loss of vehicle due to HPOTP fire may result if loss of helium to 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>	<p>1R ME-C1S, ME-G3P, ME-G3A</p>
SMC 4.1	<p>Loss of helium pressurant to operating system PCA fails to supply sufficient helium flow to maintain HPOTP intermediate seal function. Controller detects out-of-limit condition caused by reduced HPOTP intermediate seal purge flow. Controller initiates engine shutdown and enables EMSD purge sequence PAV. Overpressurization of aft compartment resulting from helium leakage. Loss of vehicle.</p> <p>Redundancy Screens: SINGLE POINT FAILURE: N/A</p>	<p>1 ME-C1S, ME-C1M, ME-C1C, ME-C1A, ME-G10C</p>

SSME EA/CIL
DESIGN

Component Group: Pneumatic Controls
CIL Item: C200-16
Component: Pneumatic Control Assembly
Part Number: R0019450
Failure Mode: Failure to contain helium.

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Design / Document Reference

FAILURE CAUSE: A: Structural failure (parent metal) of: PCA housing.
B: Structural failure (parent metal) of: Bleed valve solenoid.
C: Structural failure (parent metal) of: Emergency shutdown solenoid valve.
D: Structural failure (parent metal) of: Fuel system purge solenoid valve.
E: Structural failure (parent metal) of: HPOTP Intermediate seal purge solenoid valve.
F: Structural failure (parent metal) of: Shutdown purge solenoid valve.
G: Structural failure (parent metal) of: Emergency shutdown PAV.
H: Structural failure (parent metal) of: Fuel preburner purge PAV.
I: Structural failure (parent metal) of: Fuel system purge PAV.
J: Structural failure (parent metal) of: Oxidizer preburner purge PAV.
K: Structural failure (parent metal) of: Oxidizer bleed valve PAV.
L: Structural failure (parent metal) of: HPOTP Intermediate seal purge PAV.
M: Structural failure (parent metal) of: Emergency shutdown accumulator cap.

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THE PNEUMATIC CONTROL ASSEMBLY HOUSING (1), THE SOLENOID VALVE BODY (2), PRESSURE ACTUATED VALVE BODIES (3)(4), AND A PRESSURE ACTUATED VALVE CAP (5) ARE FABRICATED FROM 7075-T73 ALUMINUM ALLOY. THE MATERIAL IS LIGHTWEIGHT AND HAS HIGH STRENGTH AND HIGH RESISTANCE TO STRESS CORROSION CRACKING (6). THE 7075-T73 ALUMINUM IS SULFURIC ACID ANODIZED TO PROTECT PARTS FROM GENERAL CORROSION (6). THE FUEL PREBURNER PURGE PAV BODY IS INCONEL 718. INCONEL 718 HAS HIGH STRENGTH, IS CORROSION RESISTANT AND HAS HIGH STRESS CORROSION CRACKING RESISTANCE (6). THE PAV CAP (7) IS A-286. THE MATERIAL WAS SELECTED FOR ITS STRENGTH AND MODULUS OF ELASTICITY (6). THE MATERIAL FOR THE HPOTP INTERMEDIATE SEAL PURGE PAV CAP (8) AND THE PCA ACCUMULATOR CAP (9) IS 304 CRES. THE MATERIAL WAS SELECTED FOR ITS CORROSION RESISTANCE, MODULUS OF ELASTICITY AND ADEQUATE STRENGTH (6). THESE MATERIALS ARE COMPATIBLE WITH ALL OF THE USAGE ENVIRONMENTS AT THE ANTICIPATED TEMPERATURES. THE PNEUMATIC CONTROL ASSEMBLY (10) HAS PASSED DESIGN VERIFICATION TESTING (11), INCLUDING PRESSURE TESTING (12), PRESSURE CYCLING (13) AND VIBRATION TESTING (14). HIGH AND LOW CYCLE FATIGUE LIFE, AS WELL AS THE MINIMUM FACTORS OF SAFETY FOR THE PCA MEET CEI REQUIREMENTS (15). THE PCA WAS CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH, SINCE IT CONTAINS NOT FRACTURE CRITICAL PARTS (16). DISASSEMBLY AND VISUAL INSPECTION OF THE PCA FROM ENGINE 0107 SHOWED THE HOUSINGS, BODIES, AND CAP TO BE IN GOOD CONDITION WITH NO STRUCTURAL PROBLEMS (17). THE ASSEMBLY ACCUMULATED OVER 19,000 SECONDS AND 58 STARTS.

(1) R0019451; (2) RS010359; (3) RS008011; (4) R0011024; (5) RS008022; (6) RSS-8582-B; (7) R0010986; (8) R0011026; (9) R0019414; (10) R0019450; (11) DVS-SSME-610; (12) RSS-510-46; (13) RSS-510-51; (14) RSS-510-50; (15) RL00532, CP320R0003B, RSS-8546; (16) NASA TASK 117; (17) SSME-83-0230

**SSME FMEA/CIL
INSPECTION AND TEST**

Component Group: Pneumatic Controls
 CIL Item: C200-18
 Component: Pneumatic Control Assembly
 Part Number: R0019450
 Failure Mode: Failure to contain helium.

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Feature Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference	
ALL CAUSES	PNEUMATIC CONTROL ASSEMBLY		R0019450	
	HAND FORGING		R0019441	
	PCA HOUSING		R0019451	
	SOLENOID HOUSING		RS010359	
	PAV HOUSING (HPOTP VS PURGE)		R0011024	
	CAP		R0011025	
	FPB PAV HOUSING		R0010985	
	CAP		R0010986	
	PAV HOUSING		RS008011	
	CAP		RS006022	
	ACCUMULATOR CAP		RC019414	
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.		R0019441
				RS010359
				R0011024
			R0011025	
			R0010985	
			R0010986	
			RS008011	
			RS006022	
			R0019414	
	HAND FORGINGS ARE ULTRASONIC INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS		R0019441	
			R0011024	
			RS006011	
			RA0115-0*2	
	ALUMINUM ALLOY MATERIAL IS SULFURIC ANODIZED PER SPECIFICATION REQUIREMENTS.		RA1609-003	
HEAT TREAT	HEAT TREAT IS VERIFIED PER DRAWING REQUIREMENTS.		R0019451	
			R0011024	
			R0011025	
			RS010359	
			R0010985	
			R0010986	
			RS008011	
			RS006022	
ASSEMBLY INTEGRITY	MACHINED PARTS ARE PENETRANT INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS.		R0019451	
			RS010359	
			R0010985	
			R0010986	
			R0011025	

C-51

Component: Pneumatic Controls
 CIL Item: C200-16
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
ALL CAUSES	ASSEMBLY INTEGRITY	PCA HOUSING PROOF TESTED PRIOR TO ASSEMBLY. PAVs AND SOLENOID ASSEMBLIES PROOF AND LEAK TESTED SEPARATELY PRIOR TO PCA ASSEMBLY.	R0019451 R0011040 RS010341 R0010904 RS000021
	HOT-FIRE ACCEPTANCE TESTING (GREEN RUN)	PNEUMATIC CONTROL ASSEMBLY OPERATION IS VERIFIED THROUGH HOT-FIRE ACCEPTANCE TESTING.	RL00461
	PRE-FLIGHT CHECKOUT	VISUAL INSPECTION PRIOR TO AFT CLOSEOUT. ASSEMBLY VERIFIED DURING SSME ELECTRICAL CHECKOUT PRIOR TO FLIGHT OR AFTER ANY REPLACEMENT OF RELATED COMPONENTS BY PERFORMING THE FOLLOWING OMRSD REQUIREMENTS. <ul style="list-style-type: none"> - FLIGHT READINESS TEST INCLUDING PNEUMATIC SHUTDOWN. - FLIGHT READINESS TESTS AND VALVE CYCLE VERIFICATION. - PRE-CRYO LOADING. (LAST TEST) 	OMRSD V41B00.070 OMRSD V41AS0.030 OMRSD S00FA0 211 OMRSD S00FA0.213

C-52 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.