

**SSME EA/CIL**  
**REDUNDANCY SCREEN**

Component Group: Actuators  
 CIL Item: E130-11  
 Part Number: RES1008-6XXX  
 Component: Fuel Preburner Oxidizer Valve Actuator  
 FMEA Item: E130  
 Failure Mode: Structural failure.

Prepared: S. Heater  
 Approved: T. Nguyen  
 Approval Date: 6/9/00  
 Change #: 1  
 Directive #: CCBD ME3-01-5624

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Phase	Failure / Effect Description	Criticality Hazard Reference
C 4.1	<p>If in pneumatic shutdown, major pneumatic leak preventing proper pneumatic shutdown sequence. Overpressurization aft compartment. Loss of vehicle.</p> <p>Redundancy Screens: PNEUMATIC SYSTEM - ACTUATOR 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 items is not detectable during flight.            C: Fail - Loss of redundant hardware items could result from a single credible event.</p>	<p>1R            ME-A1A,            ME-B4A,C,            ME-D1A,C,            ME-G10C,D</p>

**SSME FMEA/CIL**  
**DESIGN**

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Design / Document Reference

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**FAILURE CAUSE: A: Structural failure of housing or end caps.**

THE ACTUATOR HOUSING IS MACHINED FROM A FORGED 7175 ALUMINUM BILLET, HEAT TREATED TO CONDITION T736 (1). THIS ALLOY WAS SELECTED FOR ITS TENSILE STRENGTH AND FATIGUE STRENGTH. THE EXTERIOR OF THE HOUSING IS SHOT-PEENED TO ENHANCE THE STRESS CORROSION RESISTANCE (1) (2). THE HOUSING IS ANODIZED FOR CORROSION PROTECTION AND THE CYLINDER BORES ARE HARD ANODIZED FOR WEAR RESISTANCE (3). STANDARD LEE PLUGS ARE USED TO CLOSE OFF DRILLED PASSAGE ACCESS HOLES WHERE SECONDARY RETENTION IS AVAILABLE (SUCH AS BOLTING ANOTHER PART OVER THE PLUG). OTHERWISE A "PIN PLUG" IS USED WHICH IS A LEE PLUG WITH THREADS ON THE IN-HOLE END FOR SECONDARY RETENTION (1). LEE PLUGS AND PIN PLUGS ARE ALUMINUM TO PREVENT GALVANIC CORROSION. THE BYPASS VALVE END CAP (4) IS MADE FROM 7075-T73 ALUMINUM ALLOY. THE MATERIAL IS ANODIZED FOR GENERAL CORROSION PROTECTION. 7075-T73 ALLOY IS USED FOR ITS STRENGTH AND RESISTANCE TO STRESS CORROSION CRACKING (2). THE MATERIAL IS COMPATIBLE WITH ITS OPERATING ENVIRONMENT AND HAS THERMAL PROPERTIES SIMILAR TO THE ACTUATOR HOUSING. THE PNEUMATIC CAP (5) AND SEQUENCE VALVE CAP (6) ARE MADE FROM 2024-T6 ALUMINUM ALLOY. THE MATERIAL WAS SELECTED FOR ITS STRENGTH, STRESS CORROSION RESISTANCE, AND SIMILARITY TO THE HOUSING'S THERMAL CHARACTERISTICS (2). THE CAP ANODIZING PROVIDES CORROSION PROTECTION. THE PNEUMATIC CYLINDER (7) IS MADE FROM 6081-T651 ALUMINUM. THE CYLINDER IS SHOT PEENED TO ENHANCE STRESS CORROSION RESISTANCE AND FATIGUE STRENGTH. THE CYLINDER IS ANODIZED FOR ADDITIONAL CORROSION PROTECTION. THE MATERIAL WAS SELECTED FOR ITS STRENGTH, CORROSION RESISTANCE, AND RESISTANCE TO STRESS CORROSION CRACKING (2). THE HIGH CYCLE AND LOW CYCLE FATIGUE LIFE OF THE ACTUATOR MEET CEI REQUIREMENTS (8). THE MINIMUM FACTORS OF SAFETY FOR THE ACTUATOR MEET CEI REQUIREMENTS (9). THE ACTUATOR WAS CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH, SINCE IT CONTAINS NO FRACTURE CRITICAL PARTS (10). THE ACTUATOR HAS COMPLETED DESIGN VERIFICATION TESTING (11). DVS TEST RESULTS ARE DOCUMENTED (12). AN OPOVA (WHICH IS ESSENTIALLY THE SAME AS THE SECONDS HOT FIRE TIME, INCLUDING 6,651 SECONDS AT FPL (13).

(1) 34000657; (2) RSS-8582; (3) 34000694; (4) 34000149; (5) 34001925; (6) 34000319; (7) 34001927; (8) RL00532, CP320R0003B; (9) RSS-8546, CP320R0003B; (10) NASA TASK 117; (11) DVS-SSME-512; (12) RSS-512; (13) SSME-82-2316

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**SSME FA /CIL**  
**INSPECTION AND TEST**

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference			
A	HOUSING FORGING PVA HOUSING ASSY. PVA HOUSING FORMED END CAP, BYPASS VALVE CAP, PNEUMATIC CYLINDER, PNEUMATIC END CAP, SEQUENCE VALVE  MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	34000219			
			34000694			
			34000657			
			34000149			
			34001925			
			34001927			
			34000319			
			34000219			
			34000694			
			34000657			
			34000149			
			34001925			
			34001927			
			34000319			
			HEAT TREAT	THE HOUSING FORGING IS ULTRASONIC INSPECTED PER DRAWING REQUIREMENTS. HEAT TREAT OF HOUSING IS VERIFIED TO MEET DRAWING REQUIREMENTS. SHOT PEENED HOUSING AND PNEUMATIC CYLINDER EXTERIORS ARE VERIFIED TO MEET DRAWING REQUIREMENTS. THE HOUSING AND END CAPS ARE PENETRANT INSPECTED AFTER MACHINING.		34000219
34000657						
34000657						
34001927						
34000149						
34001925						
34000319						
34000657						
34000694						
34001927						
FUNCTIONAL INTEGRITY	ANODIZE OF HOUSING, PNEUMATIC CYLINDER, AND END CAPS IS VERIFIED PER DRAWING REQUIREMENTS.  PROOF PRESSURE TESTING VERIFIES THE STRUCTURAL INTEGRITY OF THE END CAPS AND HOUSING. HOTFIRE TESTING AND SECOND E & M INSPECTIONS VERIFY SATISFACTORY OPERATION.  ACTUATOR OPERATION IS VERIFIED PRIOR TO EACH FLIGHT DURING HYDRAULIC SYSTEM CONDITIONING. ACTUATOR OPERATION IS VERIFIED DURING THE ACTUATOR CHECKOUT MODULE PRIOR TO EACH FLIGHT.					34000149
						34001925
						34000319
						34000657
						34000694
			34001927			
			RC1008			
			RL00050-04			
			RL00056-06			
			RL00056-07			
			OMRSD S00FA0.211			
			OMRSD V41AS0.010			

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	FUNCTIONAL INTEGRITY	ACTUATOR OPERATION IS VERIFIED DURING FLIGHT READINESS CHECKOUT PRIOR TO EACH FLIGHT. (LAST TEST)	OMRSD V41AS0.030

**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.