

**SSME I/CIL
REDUNDANCY SCREEN**

Component Group: Pneumatic Controls
 CIL Item: C116-02
 Component: Fuel Preburner ASI Purge Check Valve
 Part Number: RSD08059
 Failure Mode: Check valve leaks.

Prepared: P. Lowrimore
 Approved: T. Nguyen
 Approval Date: 6/2/99
 Change #: 2
 Directive #: CCBD ME3-01-5213

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Phase	Failure / Effect Description	Criticality Hazard Reference
S 4.1	<p>Oxidizer flow through failed check valve will be vented to oxidizer drain line. If leakage is sufficient, fuel and oxidizer preburner purge redline limit will be exceeded. If leakage is adequate to depress ASI mixture ratio below ignition limits, engine will be shutdown by HPFTP shaft speed ignition confirm limit. Mission scrub. Loss of vehicle due to ASI line burnout may result if check valve leaks and 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: Pass - Loss of redundant hardware items could not result from a single credible event.</p>	<p>1R ME-B2S</p>
MC 4.1	<p>Oxidizer flow through failed check valve will be vented to oxidizer drain line. Check valve leakage adequate to cause a critical failure will be detected by a redline during the start phase. Loss of vehicle due to ASI line burnout may result if check valve leaks and 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: Pass - Loss of redundant hardware items could not result from a single credible event.</p>	<p>1R ME-B2M, ME-B2C, ME-B2A</p>

**SSME FMEA/CIL
DESIGN**

Component Group: Pneumatic Controls
CIL Item: C116-02
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Part Number: RS008058
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Design / Document Reference

FAILURE CAUSE: A: Poppet jammed open.
C: Contamination between poppet and seat.

DETAIL PARTS AND TEST FIXTURES ARE CLEANED (1) PRIOR TO ASSEMBLY (2). ASSEMBLY AND TEST ARE PERFORMED IN A CLEAN ROOM (3). LUBRICANTS ARE NOT ALLOWED FOR ASSEMBLY OR TEST (2). COMPONENT LEVEL TEST FLUIDS ARE NITROGEN AND HELIUM WHICH MEET THE HARDWARE CLEANLINESS REQUIREMENTS (1). THE COMPONENT PARTS AND SUBASSEMBLY ARE FREE OF VISIBLE FOREIGN PARTICLES AT THE TIME OF ASSEMBLY (2). AT THE ENGINE LEVEL, 15-MICRON FILTERS IN BOTH THE PNEUMATIC CONTROL ASSEMBLY (4) AND LINE ASSEMBLY (11) ENSURES THAT CONTAMINANTS LARGER THAN 15-MICRONS WILL BE REMOVED. THREAD IN POPPET FACE ALLOWS BACKFLUSHING TO REDUCE AND ELIMINATE CONTAMINATION (5). THE OXIDIZER DOME PURGE PRESSURE AND THE FUEL PREBURNER ASI PURGE PRESSURE ACTUATED VALVES (5) INCORPORATE TEFLON POPPET GUIDES WHICH PREVENT METAL-TO-METAL RUBBING AND METAL PARTICLE GENERATION. A TEFLON SLEEVE ON THE CHECK VALVE POPPET ASSEMBLY (6) REDUCES FRICTION AND WEAR AND PREVENTS METAL-TO-METAL CONTACT, GALLING, AND PARTICLE GENERATION. A TEFLON SLEEVE ON THE CHECK VALVE POPPET BODY (7) PREVENTS SPRING AND BODY WEAR AND PARTICLE GENERATION. THESE DESIGN FEATURES PREVENT GENERATION OF METALLIC PARTICLES IN THE IMMEDIATE AREA OF THE BODY/POPPET INTERFACE. IN THE EVENT THAT METALLIC PARTICLES FROM ANOTHER SOURCE GET INTO THE BODY/POPPET INTERFACE, THE PARTICLES BECOME IMBEDDED IN THE TEFLON SLEEVE. THIS PREVENTS GALLING BETWEEN THE BODY AND POPPET, AND PREVENTS POPPET JAMMING. THE POPPET L/D RATIO (5), AS WELL AS THE CHECK VALVE SPRINGS (6) CLOSED END DESIGN, MINIMIZES THE PROBABILITY OF POPPET COCKING. POSITIVE STOPS ARE PROVIDED AT EACH END OF THE POPPET TRAVEL. THE POPPET (5) AND POPPET SEAT (9) ARE MANUFACTURED FROM HAYNES 188 BAR. THIS MATERIALS MODULUS OF ELASTICITY MAKES IT RESISTANT TO DAMAGE OR DEFORMATION DUE TO EXTERNAL LOADS (10).

(1) RL0001; (2) RLOG337; (3) RQ0711-800 (4) R0019450; (5) RS008058; (6) RS009214; (7) RS008217; (8) R0010733; (9) RS008220; (10) RSS-8582-6; (11) RE2317

FAILURE CAUSE: B: Broken spring.

THE SPRING (1) IS MANUFACTURED FROM ELGILDY WIRE. STRENGTH AND ELASTIC LIMIT, TOGETHER WITH ELASTIC MODULUS, ARE THE PRIMARY REASONS FOR USING ELGILDY. THE MATERIAL IS CORROSION RESISTANT AND EXHIBITS ADEQUATE RESISTANCE TO STRESS CORROSION CRACKING (2) FOR THIS APPLICATION. THE SPRING IS STRAIN RELIEVED AND INCORPORATES CLOSED AND DEBURRED ENDS, REDUCING STRESS CONCENTRATIONS THAT MAY CAUSE BREAKAGE.

(1) RSC08218; (2) MSFC-SPEC-522, RSS-8582-6

FAILURE CAUSE: D: Damaged sealing surfaces.
E: Fractured poppet.
F: Fractured seat.

THE POPPET (1) AND POPPET SEAT (2) ARE MANUFACTURED FROM HAYNES 188 BAR. THIS MATERIAL HAS HIGH MODULUS OF ELASTICITY, MAKING IT RESISTANT TO DAMAGE OR DEFORMATION DUE TO EXTERNAL LOADS. THE POPPET AND SEAT ARE TUNGSTEN CARBIDE HARDFACED FOR WEAR RESISTANCE AND RESISTANCE TO SCRATCHING OR OTHER DAMAGE. BOTH THE HAYNES 188 AND THE TUNGSTEN HARDFACING ARE RESISTANT TO CORROSION AND STRESS CORROSION CRACKING.

(1) RS008214 (2) RS008220

FAILURE CAUSE: ALL CAUSES

HIGH CYCLE AND LOW CYCLE FATIGUE, AS WELL AS THE MINIMUM FACTORS OF SAFETY FOR THE CHECK VALVES, MEET CEI REQUIREMENTS (1). THE CHECK VALVE WAS CLEARED FOR FRACTURE MECHANICS/NOE FLAW GROWTH, SINCE IT CONTAINS NO FRACTURE CRITICAL PARTS (2). THE ASSEMBLED CHECK VALVE WAS SUBJECTED TO DVS TESTING (3), INCLUDING PRESSURE TEST, PRESSURE CYCLING, VIBRATION TEST, AND ENDURANCE CYCLING (4). THE CONTROLLER MONITOR SYSTEM IS COMPRISED OF REDUNDANT SENSOR ELECTRONICS, REDUNDANT HARNESSSES, AND REDUNDANT CONTROLLER CHANNELS (5).

(1) RL00532, CP320R0003B, RSS-8548; (2) NASA TASK 117; (3) DVS-SSME-508; (4) RSS-508-34; (5) CP408R0002 PT 1 3.2.3 5.2 3.2.3 6.3

**SSME FM CIL
INSPECTION AND TEST**

Component Group: Pneumatic Controls
 CIL Item: C116-02
 Component: Fuel Preburner ASI Purge Check Valve
 Part Number: RS008059
 Failure Mode: Check valve leaks.

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A, C	FUEL, PREBURNER ASI PURGE CHECK VALVE BODY POPPET ASSEMBLY		RS008059 RS008220 RS008214
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	RS008214 RS008220
	CLEAN INESS REQUIREMENTS	COMPONENTS ARE CLEANED TO OXYGEN/FUEL SERVICE PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS008059 RS008214 RS008220 RL10001
	ASSEMBLY INTEGRITY	DURING MANUFACTURE OF THE CHECK VALVE, THE SPRING DEFLECTION AND POPPET FUNCTION ARE VERIFIED BY THE POPPET FULL STROKE DEFLECTION TEST.	RL00037
		SURFACE FINISH OF POPPET AND HOUSING BORE ARE INSPECTED PER DRAWING REQUIREMENTS.	RS008214 RS008220
		TEFLON GUIDE/POPPET CLEARANCE IS DIMENSIONALLY INSPECTED AND VERIFIED BY INTERFERENCE TEST PER DRAWING REQUIREMENT.	RS008214
		CRITICAL DEBUR OF POPPET IS INSPECTED PER DRAWING REQUIREMENTS.	
B	SPRING		R0010733
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. AFTER MACHINING, SPRING CHARACTERISTICS ARE INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RA0102 012
		LOAD RANGE OF THE DEPRESSED SPRING IS TESTED PER DRAWING REQUIREMENTS.	R0010733
D, E, F	CHECK VALVE BODY POPPET ASSEMBLY CHECK VALVE ASSEMBLY		RS008220 RS008214

C-13

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
D. E. F	CHECK VALVE BODY POPPET ASSEMBLY CHECK VALVE ASSEMBLY		RS008220 RS008214 RS008059
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	RS008220 RS008214
		TUNGSTEN HARDFACING IS INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS, INCLUDING THERMAL SHOCK AND PENETRANT INSPECTIONS.	RS008220 RS008214 RA1609-049
		SEALING SURFACES AND POPPET-SEAT FIT ARE INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS008059 RL00133
ALL CAUSES	FUEL PREBURNER ASI PURGE CHECK VALVE		RS008059
	ACCEPTANCE TESTING	THE FOLLOWING TESTS ARE PERFORMED DURING MANUFACTURE AND VALVE ACCEPTANCE: - SFAT AND SEAL LEAKAGE IS VERIFIED TO BE WITHIN SPECIFICATION. - THE INTERNAL FLOW PATH IS VERIFIED.	RL00037 RL01208 RL00037 RL01208
	PRE-FLIGHT CHECKOUT	- WORKMANSHIP AND CONTAMINATION SCREENING AT FINAL VALVE AND LINE ASSEMBLY. VALVE ASSEMBLY IS LEAK CHECKED EVERY FLIGHT AND AFTER ANY MAINTENANCE OR REPLACEMENT.	RL01208 OMRSD V41BQ0 036

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Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PACA); Reference: NASA letter SA21/88/308 and Rocketdyne letter 88RC09761.
 Operational Use: Not Applicable.

SSME EA/CIL
WELD JOINTS

Component Group: Pneumatic Controls
 CL Item: C116
 Component: Fuel Preburner ASI Purge Check Valve
 Part Number: RS008059

Prepared: P. Lowmore
 Approved: T. Nguyen
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Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Ncl Access	Critical Initial Flaw Size Not Detectable		Comments
						HCF	LCF	
CHECK VALVE	RS008059	2	EBW	II	X	X	X	ASSEMBLY OF RS007103