

**SSME FMEA/CIL**  
**REDUNDANCY SCREEN**

Component Group: Pneumatic Controls  
 CIL Item: C113-01  
 Component: Oxidizer Dome Purge Check Valve  
 Part Number: RS008059  
 Failure Mode: Fails to open or restricts flow during propellant conditioning.

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
PS 4.1	HPV warmant flow is inactive, cold soaking of component causes internal leakage. Leakage will not affect HPV operation. Loss of flow through this check valve reduces the purge flow below acceptable limits for inerting propellant leakage at ICD limits. Potential open air fire. Reduced or loss of flow to main chamber oxidizer dome causes moisture not to be cleared from dome. Ice formed during start. LOX orifices partially blocked causing combustion within the post. post burn through and extensive erosion. Loss of vehicle.	1 ME-B4S
Redundancy Screens: SINGLE POINT FAILURE: N/A		

SSME FA/CIL  
DESIGN

Component Group: Pneumatic Controls  
CIL Item: C113-01  
Component: Oxidizer Dome Purge Check Valve  
Part Number: RS00B05B  
Failure Mode: Fails to open or restricts flow during propellant conditioning.

Prepared: P. Lowrmore  
Approved: T. Nguyen  
Approval Date: 6/2/99  
Change #: 2  
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Design / Document Reference

**FAILURE CAUSE:** A: Poppet assembly jammed closed.  
B: Contamination between poppet assembly and valve body.

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, A 15-MICRON FILTER IN THE PNEUMATIC CONTROL ASSEMBLY (4) ENSURES THAT CONTAMINANTS LARGER THAN 15-MICRONS WILL BE REMOVED. THE OXIDIZER DOME PURGE PRESSURE ACTUATED VALVE (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 GUIDE BETWEEN THE SPRING AND 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 LD RATIO (5) AS WELL AS THE CHECK VALVE SPRINGS (8) CLOSED END DESIGN MINIMIZES THE PROBABILITY OF POPPET COCKING. POSITIVE STOPS ARE PROVIDED AT EACH END OF THE POPPET TRAVEL. THE POPPET (6) 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) RL10001; (2) HLD0037; (3) RQ0711-600; (4) R0019450; (5) RS00B021; (6) RS00B214; (7) RS00B217; (8) R0010733; (9) RS00B220; (10) RSS-8582-6

**FAILURE CAUSE:** C: Housing weld or parent material failure.

THE BODY (1) AND CAP (2) ARE MADE FROM HAYNES 188. HAYNES WAS SELECTED FOR ITS STRENGTH, WELDABILITY, GENERAL CORROSION RESISTANCE, AND RESISTANCE TO STRESS CORROSION CRACKING (3). THE CAP AND BODY ARE CONNECTED BY AN ELECTRON BEAM WELD. THE WELD IS CONTROLLED BY SPECIFICATION TO ENSURE HIGH QUALITY AND PRODUCEABILITY (4).

(1) RS00B220; (2) RS00B213; (3) RSS-8582; (4) RA0607-094

**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/INDE FLAW GROWTH BY CRITICAL INITIAL FLAW SIZE DETECTABILITY (2). TABLE C113 LISTS THE CHECK VALVE FMEAI/CIL WELDS. WELD NO. 2 DOES NOT HAVE ROOT SIDE ACCESS FOR INSPECTION. THIS WELD IS ACCEPTABLE FOR FLIGHT BY RISK ASSESSMENT (2). THE ASSEMBLED CHECK VALVE WAS SUBJECT TO DVS TESTING (3), INCLUDING PRESSURE TEST, PRESSURE CYCLING, VIBRATION TEST, AND ENDURANCE CYCLING (4).

(1) RL00532, CP320R0003B, RSS-8546; (2) RSS-8756; (3) DVS-SSME-508; (4) RSS-508-34

**SSME FMEA/CIL  
INSPECTION AND TEST**

Component Group: Pneumatic Controls  
 CIL Item: C113-01  
 Component: Oxidizer Dome Purge Check Valve  
 Part Number: RS008059  
 Failure Mode: Falls to open or restricts flow during propellant conditioning.

Prepared: P. Lowrimore  
 Approved: T. Nguyen  
 Approval Date: 6/2/99  
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Failure Causes	Significant Characteristics	Inspector(s) / Test(s)	Document Reference
A, B	OXIDIZER DOME PURGE CHECK VALVE BODY POPPET ASSEMBLY		RS008059 RS008220 RS008214
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	RS008214 RS008220
	CLEANLINESS 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 AND SPECIFICATION REQUIREMENTS.	RS008059 RL00037
		CRITICAL DEBUR OF POPPET IS INSPECTED PER DRAWING REQUIREMENTS.	RS008214
C	OXIDIZER DOME PURGE CHECK VALVE BODY CAP		RS008059 RS008220 RS008213
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	RS008220 RS008213

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Component: Pneumatic Controls  
 CIL Item: C113-01  
 Component: Oxidizer Dome Purge Check Valve  
 Part Number: RS008059  
 Failure Mode: Fails to open or restricts flow during propellant conditioning.

Prepared: P. Lowrie  
 Approved: T. Nguyen  
 Approval Date: 8/2/99  
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
C	WELD INTEGRITY	ALL WELDS ARE INSPECTED TO DRAWING AND SPECIFICATION REQUIREMENTS PER WELD CLASS. INSPECTIONS INCLUDE: VISUAL, DIMENSIONAL, PENETRANT, RADIOGRAPHIC, ULTRASONIC, AND FILLER MATERIAL AS APPLICABLE. UNVERIFIABLE ROOT WELDS ARE INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS AS APPLICABLE.	RL10011 RA0607-094 RA0115-116 RA0115-006 RA0115-127 RA1115-001
ALL CAUSES	ACCEPTANCE TESTING	THE FOLLOWING TESTS ARE PERFORMED DURING MANUFACTURE AND VALVE ACCEPTANCE: - THE CHECK VALVE IS PROOF PRESSURE TESTED WITH PRESSURE APPLIED TO THE INLET AND OUTLET. - SEAT AND SEAL LEAKAGE IS VERIFIED TO BE WITHIN SPECIFICATION. - THE INTERNAL FLOW PATH IS VERIFIED. - WORKMANSHIP AND CONTAMINATION SCREENING AT FINAL VALVE AND LINE ASSEMBLY	RL00037 RL01208 RL00037 RL01208
	HOT-FIRE ACCEPTANCE TESTING (GREEN RUN)	COMPONENT OPERATION IS VERIFIED THROUGH HOT-FIRE ACCEPTANCE TESTING.	RL01208 RL00461
	PRE-FLIGHT CHECKOUT	VALVE ASSEMBLY IS LEAK CHECKED EVERY FLIGHT AND AFTER MAINTENANCE OR REPLACEMENT. (LAST TEST)	OMRSD V41B00.036

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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.

**SSME FMEA/CIL**  
**WELD JOINTS**

Component Group: Pneumatic Controls  
 CIL Item: C113  
 Component: Oxidizer Dome Purge Check Valve  
 Part Number: RS008059

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 Approved: T. Nguyen  
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Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial Flaw Size Not Detectable		Comments
						HCF	LCF	
CHECK VALVE	RS008059	2	EBW	II	X	X	X	ASSEMBLY OF R0010747