

**SSWIE FMEA/CIL  
REDUNDANCY SCREEN**

Component Group: Combustion Devices  
CIL Item: A700 04  
Part Number: RSD09004  
Component: Oxidizer Preburner  
FMEA Item: A700  
Failure Mode: Non-uniformity of fuel flow in the injection element occurs.

Prepared: A. Kay  
Approved: T. Nguyen  
Approval Date: 9/9/99  
Change #: 1  
Directive #: CCBD MEC-01-523B

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Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Significant non-uniformity can cause local high mixtures and recirculation of gases around the elements periphery which might cause local erosion of the injection element tip, the injector faceplate, the combustion zone liner or the injector baffle. Erosion through the liner may result in burnthrough of the structural wall. Loss of vehicle	1 ME-BGS, ME-RGA C, ME-BSM
	Redundancy Screens: SINGLE POINT FAILURE. N/A	

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**SSME FA/CIL  
DESIGN**

Component Group: Combustion Devices  
CIL Item: A700-04  
Part Number: RS009004  
Component: Oxidizer Preburner  
FMEA Item: A700  
Failure Mode: Non-uniformity of fuel flow in the injection element occurs.

Prepared: A. Kay  
Approved: T. Nguyen  
Approval Date: 9/9/99  
Change #: 1  
Directive #: CCBD ME3-01-5238

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Design / Document Reference

FAILURE CAUSE: A: Contamination in the fuel annulus.

THE FUEL IS FILTERED TO 400-MICRONS AT THE EXTERNAL TANK (1). THE PREBURNER INJECTION ELEMENT (2) CONSISTS OF A FUEL SLEEVE ENCIrcLING A LOX POST WITH THE TWO BRAZED TOGETHER. THE GAP BETWEEN THE LOX POST AND THE FUEL SLEEVE IS CONTROLLED (2) (3). THE FUEL PASSAGE IS FED BY A SERIES OF SMALL HOLES EQUALLY SPACED AROUND THE EXTERNAL SLEEVE IN STAGGERED ROWS. THE HOLES ARE SMALLER IN DIAMETER THAN THE ANNULUS DIMENSIONS. THIS SYSTEMS ACTS AS A FILTER FOR THE ANNULUS. THE PREBURNER INJECTOR ELEMENT HAS BEEN DESIGN VERIFICATION TESTED FOR ELEMENT CONTAMINATION (4). INSPECTIONS OF THE PREBURNERS IN ENGINE 2010 REVEALED NO CONTAMINATION IN THE FUEL ANNULUS (5). A REVIEW OF THE PREBURNER UCR DATA SHOWED LOW OCCURRENCE RATE OF CONTAMINATED PASSAGES. 2 OF 5 CAUSED EROSION/SELF-CONTAINED DAMAGE.

(1) ICD 13M15000; (2) RS009009; (3) RS009004; (4) DVS-305-5; (5) MPR-86-0137

FAILURE CAUSE: B: Non-concentric posts.

TOLERANCES ON THE ELEMENT ASSEMBLY DRAWING ALONG WITH SUBSEQUENT ASSEMBLY REQUIREMENTS CONTROL CONCENTRICITY OF THE POSTS (1) (2) (3). INSPECTIONS OF THE PREBURNERS IN ENGINE 2010 REVEALED NO PROBLEMS WITH CONCENTRICITY (4) (5).

(1) RS009009; (2) RS009004; (3) RL00050-04; (4) MPR 86-0139; (5) RL00572

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**SSME FMEA/CIL**  
**INSPECTION AND TEST**

Component Group: Combustion Devices  
 CIL Item: A700-04  
 Part Number: RS009004  
 Component: Oxidizer Preburner  
 FMEA Item: A700  
 Failure Mode: Non-uniformity of fuel flow in the injection element occurs.

Prepared: A. Kay  
 Approved: T. Nguyen  
 Approval Date: 8/9/99  
 Change #: 1  
 Directive #: CC80 MEJ-01-5238

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	PREBURNER INJECTOR ELEMENT  CLEANLINESS	POSTS ARE CLEANED PER SPECIFICATION REQUIREMENTS  AFTER BRAZING THE POSTS ARE INSPECTED FOR BLOCKAGE PER SPECIFICATION REQUIREMENTS.  UPSTREAM COMPONENTS ARE VERIFIED CLEAN TO FUEL SERVICE PER SPECIFICATION REQUIREMENTS.	RS009009  RA0110-018  RA1607-004 RA1607-007  RL10001
B	PREBURNER INJECTOR ELEMENT  MATERIAL INTEGRITY  ASSEMBLY INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.  AFTER BRAZING THE POSTS ARE INSPECTED FOR PROPER POSITIONING.  POST CONCENTRICITY IS CHECKED EVERY TIME HPOTP IS REMOVED NOT TO EXCEED 3.500 SECONDS	RS009009  RS009023 RA1607-004 RA1607-007  OMRSD V41BU0-032
ALL CAUSES	ASSEMBLY INTEGRITY	THE HOT FIRE TESTING AND 2ND I & M INSPECTIONS VERIFY PREBURNER INTEGRITY.  AFTER EACH FLIGHT A VISUAL INSPECTION IS PERFORMED TO CHECK FOR EVIDENCE OF THERMAL DAMAGE TO THE INJECTOR ASSEMBLY.	RL00050-04 RL00055-06 RL00056-07  OMRSD V41BU0-040

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)

Reference: NASA letter SA21/88/308 and Rocketdyne letter 88RCC0751.

Operational Use: Not Applicable

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**SSME FMEA/CIL  
WELD JOINTS**

Component Group: Combustion Devices  
 CIL Item: A700  
 Component: RS009004  
 Part Number: Oxidizer Preburner  
 A700

Prepared: A. Kay  
 Approved: T. Nguyen  
 Approval Date: 9/9/99  
 Change #: 1  
 Directive #: CCBD ME3-01-5238  
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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	
OPB CHAMBER	RS009003	1,2	GTAW	I	X	X	X	(A050)
OPB CHAMBER	RS009003	1(60DEG)	GTAW	II	X	X	X	(A050)
OPB INJECTOR	RS009004	1	EBW	II	X	X	X	
OPB INJECTOR	RS009004	2	EBW	I	X			
OPB INJECTOR	RS009004	3	GTAW	I	X			
OPB INJECTOR	RS009004	9	EBW	II	X			
OPB INJECTOR	RS009004	28	FBW	II	X			
OPB INJECTOR	RS009004	29	EBW	II	X			
OPB BODY	RS009007	1	GTAW	II	X			(A050)
OPB BODY	RS009007	2	EBW	II	X			(A050)
OPB BODY	RS009007	3	EBW	I				(A050)
OPB BODY	RS009007	4 (OPT)	GTAW	I	X			(A050)
OPB BODY	RS009007	10,11	GTAW	I	X	X	X	(A050)
OPB BODY	RS009007	12	GTAW	I	X		X	(A050)
OPB BODY	RS009007	13	GTAW	I	X	X	X	(A050)
OPB BODY	RS009007	14	GTAW	I	X	X	X	(A050)
OPB BODY	R0018067	1	GTAW	II	X	X	X	
OPB BODY	R0018067	2	EBW	I	X			
OPB BODY	R0018067	6	GTAW	I	X			
OPB BODY	R0018067	7	GTAW	I	X			
OPB FUEL MANIFOLD	RS009013	9(OPT)10 (OPT)	GTAW	I		X	X	(A050)
OPB FUEL MANIFOLD	RS009013	11 (OPT)	GTAW	I		X	X	(A050)
OPB FUEL MANIFOLD	RS009013	13 (OPT)	GTAW	I	X			(A050)
OPB OXID INLET	RS009014	6-8	GTAW	I		X		
OPB LINER	RS009015	2-17	GTAW	II	X			(A050)
OPB ASI FUEL LINE	RS009024	1	GTAW	I	X	X	X	(A050)
OPB CHAMBER	RS009003	3 (OPT) 4 (OPT)	GTAW	I		X	X	(A050)
OPB CHAMBER	RS009003	5 (OPT)	GTAW	I		X	X	(A050)
OPB CHAMBER	RS009003	6 (OPT)	GTAW	I	X			