

**SSME FA/CIL  
REDUNDANCY SCREEN**

Component Group: Combustion Devices  
CIL Item: A800-11  
Part Number: RS008020  
Component: Fuel Preburner  
FMEA Item: A800  
Failure Mode: External rupture.

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

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Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Leakage into the aft compartment will cause overpressurization and/or fire. Loss of vehicle.  Redundancy Screens: SINGLE POINT FAILURE: N/A	MF-B2C, MF-B2A,C, MF-B2M

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SSME FMEA/CIL  
DESIGN

Component Group: Combustion Devices  
CIL Item: A600-11  
Part Number: RS009020  
Component: Fuel Preburner  
FMEA Item: A600  
Failure Mode: External rupture.

Prepared: A. Kay  
Approved: T. Nguyen  
Approval Date: 9/9/99  
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Design / Document Reference

FAILURE CAUSE: A: Failure of parent material or weld.

THESE ASSEMBLIES USE INCONEL 718 ALLOY, INCONEL 625 ALLOY AND INCOLOY 903 ALLOY (1). INCONEL 718 WAS CHOSEN FOR ITS STRENGTH AND RESULTING WEIGHT SAVINGS, ALONG WITH ITS CRYOGENIC DUCTILITY, AND OXYGEN COMPATIBILITY (2). THE INCONEL 625 ALLOY WAS CHOSEN BECAUSE OF ITS BRAZABILITY, WELDABILITY, MACHINABILITY, AND MATERIAL PROPERTIES (2). INCOLOY 903 WAS CHOSEN BECAUSE OF ITS STRENGTH AND THE FACT THAT IT IS RESISTANT TO HIGH-PRESSURE HYDROGEN ENVIRONMENTAL EFFECTS (2). HIGH CYCLE FATIGUE LIFE, LOW CYCLE FATIGUE LIFE, AND MINIMUM FACTORS OF SAFETY FOR THE PREBURNER ASSEMBLY MEET CFI REQUIREMENTS (3). THE PREBURNER ASSEMBLY PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH SINCE THEY ARE NOT FRACTURE CRITICAL PARTS, EXCEPT FOR THE FUEL MANIFOLD WHICH WAS CLEARED BY CRITICAL INITIAL FLAW SIZE DETECTABILITY (4). THE FMEA/CIL WELDS ARE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH BY THE WELD ASSESSMENT (5). TABLE A600 LISTS ALL FMEA/CIL WELDS AND IDENTIFIES THOSE WELDS IN WHICH THE CRITICAL INITIAL FLAW SIZE IS NOT DETECTABLE AND THOSE WELDS IN WHICH THE ROOT SIDE IS NOT ACCESSIBLE FOR INSPECTION. THOSE WELDS IN WHICH THE CRITICAL INITIAL FLAW SIZE IS NOT DETECTABLE ARE ACCEPTABLE FOR FLIGHT BY RISK ASSESSMENT (5). DISASSEMBLY OF ENGINE 2010 REVEALED SHRINKAGE CRACKS STARTING AT THE ELECTRON BEAM SPAL WELD BETWEEN THE INJECTOR AND BODY (6), AND ENDING IN THE PARENT MATERIAL OF THE INCONEL 718 BODY (7). ME & T ANALYSIS REVEALED NO FATIGUE GROWTH. STRUCTURAL ANALYSIS OF THIS AREA USING WORST CASE ASSUMPTIONS (i.e. EXPOSED TO HYDROGEN) SHOWS THE WORST POSSIBLE DEFECT TO BE ACCEPTABLE. THE PREBURNER WAS DVS TESTED (8).

(1) RS009023, RS000074, RS009029; (2) RSS-8571-9; (3) RI 00532, CP320RC0030, RSS-8546; (4) NASA TASK 117; (5) RSS-8756; (6) RS007051; (7) MPR-85-0884; (8) LVS-305

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**SSME FM CIL  
INSPECTION AND TEST**

Component Group: Combustion Devices  
 CIL Item: A600-11  
 Part Number: RS009020  
 Component: Fuel Preburner  
 FMEA Item: A600  
 Failure Mode: External rupture.

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	CHAMBER ASSEMBLY PREBURNER ASSEMBLY FUEL INLET, ASI FUEL ASI TUBE FUEL ASI FLANGE FUEL MANIFOLD BODY ASSEMBLY		RS009019 RS009020 RS009018 RS009525 RS009435 RS009029 RS009023
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0170-152 RB0170-185
		ULTRASONIC INSPECTION IS PERFORMED ON THE FORGINGS PER SPECIFICATION REQUIREMENTS.	RA0115-012
		TUBING IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RB0170-213
		TUBING IS ULTRASONICALLY INSPECTED PER SPECIFICATION REQUIREMENTS.	
	HEAT TREAT	HARDNESS TEST VERIFIES HEAT TREAT IS WITHIN REQUIREMENTS.	RAC011-020
	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.	RL10011 RAC007-094 RAC115-116 RAC115-00E RA0115-127 RA1115-001
		THE PREBURNER TO HOT-GAS MANIFOLD WELD 42 (RS007051) IS SPECIALLY INSPECTED FOR JOINT INTEGRITY THROUGH INSPECTION HOLES DRILLED IN EB WELD.	RAC115-116 RL00456
	ASSEMBLY INTEGRITY	ASSEMBLY IS PROOF PRESSURE TESTED.	RL00177 RA0115-116
		AFTER PROOF PRESSURE TEST THE ACCESSIBLE WELDS ARE PENETRANT INSPECTED.	RL00177
		THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY PREBURNER INTEGRITY.	RL00056-04 RL00056-05 RL00056-07
		THE HELIUM SIGNATURE LEAK TEST PERFORMED PRIOR TO EACH LAUNCH VERIFIES THAT THE WELD AND THE PARENT MATERIAL REMAINS INTACT. (LAST TEST)	OMRSD S00000.950

Component Group: Combustion Devices  
C/L Item: A600-11  
Part Number: RS009020  
Component: Fuel Preburner  
FMEA Item: A600  
Failure Mode: External rupture.

Prepared: T. Nguyen  
Approved: T. Nguyen  
Approval Date: 9/9/99  
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
Failure History:	Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/FRACA) Reference: NASA letter SA21/88/108 and Rocketdyne letter 88RC097B1.		
Operational Use:	Not Applicable		

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**SSME F A/CIL  
WELD JOINTS**

Component Group: Combustion Devices  
 CIL Item: A600  
 Component: RS009020  
 Part Number: Fuel Preburner  
 A600

Prepared: A. Kay  
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Component	Basic Part Number	Weld Number	Weld Type	Class	Access	Critical Initial Flaw Size Not Detectable		Comments
						Root Side Not	HCF LCF	
FPB CHAMBER	RS009019	1,2	GTAW	I	X	X	X	
FPB INJECTOR	RS009020	1	EBW	II	X	X	X	
FPB INJECTOR	RS009020	2	EBW	II	X			
FPB INJECTOR	RS009020	3	GTAW	I	X	X	X	
FPB INJECTOR	RS009020	9	EBW	II	X			
FPB INJECTOR	RS009020	38	EBW	II	X			
FPB INJECTOR	RS009020	39	EBW	II	X			
FPB BODY	RS009023	1 (OPT)	GTAW	I	X			(AC50)
FPB BODY	RS009023	5	EBW	I	X			(AC50)
FPB FUEL MANIFOLD	RS009029	7 (OPT), 8 (OPT)	GTAW	I		X	X	(AC50)
FPB FUEL MANIFOLD	RS009029	11 (OPT)	GTAW	I		X		(AC50)
FPB FUEL MANIFOLD	RS009029	13 (OPT)	GTAW	I		X		(AC50)
FPB OXID INLET	RS009030	1	GTAW	I		X		
FPB OXID INLET	RS009030	2	GTAW	I	X	X	X	
FPB OXID INLET	RS009030	4	GTAW	I				
PREBURNER EXPANSION JOINT	RS009032	1	GTAW	I				
PREBURNER EXPANSION JOINT	RS009032	2,3	GTAW	II	X			
FPB ASH FUEL LINE	RS009026	1 PLC	GTAW	I	X			
FPB CHAMBER	RS009019	3 (OPT), 4 (OPT)	GTAW	I		X	X	(AC50)
FPB CHAMBER	RS009019	5 (OPT)	GTAW	I		X		(AC50)
FPB CHAMBER	RS009019	6 (OPT)	GTAW	I		X		(AC50)

**SSME FMEA/CIL  
FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE**

Component Group: Combustion Devices  
 Item Name: Fuel Preburner  
 Item Number: A603  
 Part Number: RS009920

Prepared: A. Kay  
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 Approval Date: 9/9/99  
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Base Line Rationale	Variance	Change Rationale	Variant Dash Number
1. A603- NO RATIONALE EFFECTED.	MDLY LINER IS INSTALLED IN VARIOUS PREBURNER ASSEMBLIES.	LINER MAY BECOME DAMAGED. USE AS IS RATIONALE; DEBONDED LINER HAS BEEN DETERMINED TO BE A CRITICALITY THREE.	RS007051-1441 RS007051-1457

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