

SSME / A/CIL
REDUNDANCY / SCREEN

Component Group: Combustion Devices
 CIL Item: A600-10
 Part Number: RS002020
 Component: Fuel Preburner
 FMEA Item: A600
 Failure Mode: External rupture.

Prepared: A. Kay
 Approved: T. Nguyen
 Approval Date: 9/9/99
 Change #: 1
 Directive #: CCBD ME3-01-5236
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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	ME-D2S ME-B2A.C. ME-B2M

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SSME FMEA/CIL
DESIGN

Component Group: Combustion Devices
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Design / Document Reference

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

THE DOME AND OXIDIZER INLET ARE CONSTRUCTED OF INCONEL 718. THE STRENGTH OF INCONEL 718 AFTER HEAT TREATMENT IS THE PRIMARY REASON FOR ITS SELECTION. OTHER DESIRABLE PROPERTIES OF INCONEL 718 ARE ITS CRYOGENIC DUCTILITY AND OXYGEN COMPATIBILITY (1). THE ASI OXIDIZER SUPPLY LINES AND INTERPROPELLANT PLATE ARE MADE OF INCONEL 525. INCONEL 525 IS READILY WELDED TO INCONEL 718 AND EXHIBITS RESISTANCE TO STRESS CORROSION, CRYOGENIC DUCTILITY, AND OXYGEN COMPATIBILITY (1). PRIMARY FACTORS OF SAFETY MEET CEI REQUIREMENTS (2). HIGH CYCLE FATIGUE AND LOW CYCLE FATIGUE LIFE MEET CEI REQUIREMENTS (3). OFFSET LIMIT REQUIREMENTS ARE ESTABLISHED TO REDUCE STRESS CONCENTRATIONS AND IMPROVE WELD GEOMETRY (4). CRITICAL WELD BEADS ARE MACHINED FLUSH TO REDUCE STRESS CONCENTRATIONS (5). THE ASI LOX INLET LINE IS WRAPPED WITH GRAPHITE EPOXY FOR ADDITIONAL STRUCTURAL STRENGTH (6). DURING THE TEARDOWN OF ENGINE 2010, SHRINKAGE CRACKS WERE OBSERVED EMANATING FROM THE ELECTRON BEAM WELD BETWEEN THE INJECTOR AND BODY IN THE AREA OF THE INCOLOY 903 OVERLAY ON THE INTERPROPELLANT PLATE. ME & T ANALYSIS OF THIS CRACK SHOWED THAT THERE WAS NO FATIGUE PROPAGATION OF THE CRACK. STRUCTURAL ANALYSIS OF THE AREA SHOWS THE DEFECT TO BE ACCEPTABLE, EVEN IF THE WORST CASES ARE ASSUMED (7). THE PREBURNER PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH SINCE THEY CONTAIN NO FRACTURE CRITICAL PARTS (8). THE FMEA/CIL WELDS ARE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH BY THE WELD ASSESSMENT (7). TABLE A800 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 (9). THE PREBURNER WAS CVS TESTED (10).

(1) RSS-8571-9; (2) RSS-9548, CP320R0003B; (3) RI.00532, CP320R0003B; (4) RI.10011; (5) ECP 948 RS009030; (6) RS007004; (7) MPR 86 0854; (8) NASA TASK 117; (9) RSS-0759; (10) DVS-305

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INSPECTION AND TEST

Component Group: Combustion Devices
 CIL Item: A600-10
 Part Number: RS009020
 Component: Fuel Preburner
 FMEA Item: A600
 Failure Mode: External rupture.

Prepared: A. Kay
 Approved: T. Nguyen
 Approval Date: 9/3/09
 Change #: 1
 Directive #: CCBD ME3-01-8238

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference	
A	DOME OXID INLET ASSEMBLY INTERPROPELLANT PLATE ASI INLET ASI INLET FLANGE ASI OXIDIZER TUBE ASI INLET FLANGE INSERT ASSY MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RS009021 RS009030 RS009024 RS009035 RS009029 R0011052 RS009096 RG000010	
		ULTRASONIC INSPECTION IS PERFORMED ON THE FORGINGS PER SPECIFICATION REQUIREMENTS.	RB0170-153 RA0115-012	
		A PENETRANT INSPECTION OF THE MACHINED DOME AFTER HEAT TREAT PRIOR TO FINAL MACHINING VERIFIES NO CRACKS.	RA0115-115	
		TUBING IS ULTRASONIC AND PENETRANT INSPECTED (OUTER DIAMETER) FOR DEFECTS PER SPECIFICATION REQUIREMENTS.	RB0170-213 RA0115-124 RA0115-112	
		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 RAC07-094 RA0115-115 RAC115-005 RAC115-127 RA1115-001
		ASSEMBLY INTEGRITY	LOX INLET ELBOW WELDS 1 AND 4 FACE AND ROOT SIDE GEOMETRY IS VERIFIED PER DRAWING REQUIREMENTS	RS009030 ECP 048
			A SPECIAL INSPECTION OF THE INNER AND EXTERIOR CIRCUMFERENTIAL DOME WELDS IS PERFORMED. (INCLUDING BORING, ETCH, PENETRANT, AND PLUG WELDING)	RL20456 RL20256
			A PROOF PRESSURE TEST IS PERFORMED ON THE ASSEMBLY.	RL20177
			A PENETRANT INSPECTION AFTER PRESSURE TEST VERIFIES NO CRACKS.	RA0115-116
	THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY INTEGRITY OF PREBURNER.	RL00356-01 RL00356-06 RL00356-07		
	THE HELIUM SIGNATURE LEAK TEST PERFORMED PRIOR TO EACH FLIGHT VERIFIES DOME INTEGRITY. (LAST TEST)	OMRSU 800003.950		

Component Group: Combustion Devices
CJL Item: A600-10
Part Number: RS009020
Component: Fuel Preburner
FMEA Item: A500
Failure Mode: External rupture.

Approved: T. Nguyen
Approval Date: 9/9/99
Change #: 1
Directive #: CCBD ME3-01-6218

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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/PRACA) Reference: NASA letter SA21798/308 and Rocketdyne letter 88RC09761.		
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
 Approved: T. Nguyen
 Approval Date: 9/9/99
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Component	Basic Part Number	Weld Number	Weld Type	Class	Access	Critical Initial Flaw Size Not		Comments
						Root Side Not	Detectable	
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
 Approved: T. Nguyen
 Approval Date: 9/9/99
 Change #: 1
 Directive #: CCBD ME3-01-5235

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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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