

SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group: Combustion Devices
CIL Item: A700-11
Part Number: RS009004
Component: Oxidizer Proburner
FMEA Item: A700
Failure Mode: External rupture.

Prepared: A. Kay
Approved: T. Nguyen
Approval Date: 9/3/99
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	1 ME-B6S, MF-B6A,C, ME-B6M

SSME F A/CIL
DESIGN

Component Group: Combustion Devices
CIL Item: A700-11
Part Number: R5009004
Component: Oxidizer Preburner
FMEA Item: A700
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Design / Document Reference

FAILURE CAUSE: A: Weld or parent material failure.

THESE ASSEMBLIES USE INCONEL 718 ALLOY, INCONEL 625 ALLOY, AND INCOLOY 903 ALLOY (1). THE 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 BRAZEABILITY, WELDABILITY, MACHINABILITY, AND MATERIAL PROPERTIES (2). THE INCOLOY 903 WAS CHOSEN BECAUSE OF ITS STRENGTH AND ITS RESISTANCE TO HIGH-PRESSURE HYDROGEN ENVIRONMENTAL EFFECTS (2). HIGH CYCLE FATIGUE, LOW CYCLE FATIGUE LIFE, AND MINIMUM FACTORS OF SAFETY FOR THE PREBURNER ASSEMBLY MEET CEI REQUIREMENTS (3) EXCEPT THE FUEL TORUS IS LIFE LIMITED BY MAJOR WAIVER (4). THE PREBURNER PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH SINCE IT CONTAINS NO FRACTURE CRITICAL PARTS (5). THE FMEA/CIL WELDS ARE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH BY THE WELD ASSESSMENT (6). TABLE A700 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 (6). DISASSEMBLY OF ENGINE 2010 REVEALED SHRINKAGE CRACKS STARTING AT THE ELECTRON BEAM SEAL WELD BETWEEN THE INJECTOR AND BODY (7), AND ENDING IN THE PARENT MATERIAL OF THE INCONEL 718 BODY (8). 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. (NOTE: THE OXIDIZER AND FUEL SIDE ARE SIMILAR IN THIS AREA.) THE PREBURNER WAS DVS TESTED (9).

(1) R5009007, R5009008, R5009013; (2) RSS-3571-0; (3) RL00532, CP320R0003B, RSS 8548; (4) DAR 2084; (5) NASA TASK 117; (6) RSS-8756; (7) R5007051; (8) MFR-EG-0894; (9) DVS-305

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**SSME FMEA/CIL
INSPECTION AND TEST**

Component Group: Combustion Devices
 CL Item: A708-11
 Part Number: RS009004
 Component: Oxidizer Preburner
 FMEA Item: A708
 Failure Mode: External rupture.

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

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	BODY ASSEMBLY PREBURNER ASSEMBLY FUEL INLET AS: MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RS009C03 RS009C04 RS009C16 RBD170-163 RBD170-186
		ULTRASONIC INSPECTION IS PERFORMED ON THE FORGINGS PER SPECIFICATION REQUIREMENTS.	RA0115-012
		TUBING IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RRC170-213
		TUBING IS ULTRASONICALLY INSPECTED PER SPECIFICATION REQUIREMENTS.	
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0511-020
	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 RA0507-034 RA0115-116 RA0115-006 RA0115-127 RA1115-001
		PREBURNER TO HOT GAS MANIFOLD WELD 41 (RS007051) IS SPECIALLY INSPECTED FOR JOINT INTEGRITY THROUGH INSPECTION HOLES DRILLED IN EB WELD.	RA0115-116 RL00456
	ASSEMBLY INTEGRITY	ASSEMBLY IS PROOF PRESSURE TESTED PER SPECIFICATION REQUIREMENTS.	RL00177
		PENETRANT INSPECTION IS PERFORMED ON THE ASSEMBLY AFTER PROOF PRESSURE TEST	RA0115-116
		THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY INJECTOR INTEGRITY.	RL00056-04 RL00056-06 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

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Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA).
 Reference: NASA letter SA2188/308 and Rocketdyne letter 88RC08751.

Operational Use: Not Applicable.

**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
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Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial		Comments
						Flaw Size Not	Defectable	
						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-E	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			