

**SSME FMEA/CIL
REDUNDANCY SCREEN**

Component Group: Combustion Devices
 CIL Item: A700-D2
 Part Number: RS009004
 Component: Oxidizer Preburner
 FMEA Item: A700
 Failure Mode: Loss of fuel to ASI.

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
SMC 4.1	Loss of fuel to ASI causes high mixture ratio erosion of the ASI combustion chamber walls, injector burnout, loss of turbine, and engine failure. Loss of vehicle.	Hazard: Retardance
	Redundancy Screens: SINGLE POINT FAILURE: N/A	ME-B65 ME-B5A C, ME-B3M

SSME MAIN ENGINE
DESIGN

Component Group: Combustion Devices
CIL Item: A700-02
Part Number: RS009004
Component: Oxidizer Preburner
FMEA Item: A700
Failure Mode: Loss of fuel to ASI.

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Design / Document Reference

FAILURE CAUSE: A: Contamination of the ASI fuel orifices or passageways.

THE FUEL ASI DELIVERY SYSTEM IS DESIGNED TO REMOVE ANY PARTICLES THAT MAY CAUSE CUTOFF OR PARTIAL BLOCKAGE OF THE PASSAGES. A FILTER IS LOCATED AT THE HEAD OF THE DELIVERY SYSTEM THAT REMOVES PARTICLES FROM THE FUEL THAT MAY BE LARGE ENOUGH TO CAUSE A REDUCTION IN FUEL FLOW (1). THE FILTER IS DESIGNED TO STOP PARTICLES IN THE FUEL AND ALLOW THEM TO SETTLE OFF THE FILTER FACE (2). THIS ALLOWS FOR PARTICLE REMOVAL WITHOUT FILTER FLOW REDUCTION, SHOULD GROSS CONTAMINATION OCCUR. THE FILTER CAN WITHSTAND PLUGGING OF OVER HALF OF ITS SURFACE AREA PRIOR TO A REDUCTION IN ASI CHAMBER FUEL DELIVERY. THE ASI CAN OPERATE OVER A VERY WIDE MIXTURE RATIO RANGE AND PARTIAL BLOCKAGE CAN STILL ALLOW TIMELY IGNITION OF THE PROPELLANTS. THE FUEL IS FILTERED TO 400-MICRONS AT THE EXTERNAL TANK PRIOR TO USE BY THE MAIN ENGINES (3). THE ASI FUEL FILTER IS FABRICATED FROM INCONEL 625 ALLOY WHICH WAS SELECTED BECAUSE OF ITS BRAZABILITY, WELDABILITY, MACHINABILITY AND MATERIAL PROPERTIES (4). INCONEL CAN BE BRAZED WITHOUT PLATING IN A CONTROLLED ATMOSPHERE. THE FUEL FILTER IS BRAZED IN EITHER HYDROGEN, ARGON AND HELIUM, HELIUM, OR VACUUM (5). ASI FUEL FILTER HAS BEEN ANALYZED FOR FLOW INDUCED LOADS, DYNAMIC LOADS, AND PRESSURE LOADS AND MEETS THE HIGH CYCLE AND LOW CYCLE FATIGUE LIFE CEI REQUIREMENTS (6). THE MINIMUM FACTORS OF SAFETY FOR THE ASI FUEL FILTER MEET CEI REQUIREMENTS (7). THE ASI IGNITION SYSTEM HAS BEEN DESIGNED AND VERIFICATION TESTED FOR LOW PRESSURE IGNITION AND LOW MIXTURE RATIOS. DESIGN TESTING OF THE FILTER WITH INDUCED CONTAMINATION SHOWED THE FLOW WASHES THE FILTER. THE FLEET LEADER ASI FUEL FILTER HAS BEEN REMOVED FROM SERVICE FOR MICROSCOPIC AND PENETRANT INSPECTION ON TWO OCCASIONS WITHOUT DETECTING ANY ANOMALIES (8).

(1) RS007004; (2) R0019225; (3) ICD 13M15000; (4) RSS-857-9; (5) RAG107-010; (6) RL00532 CP320R0003B; (7) RSS-8548 CP320R0003B; (8) 1L NFR-55-C30911, MPR-05-0550

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**SSME FMEA/CIL
INSPECTION AND TEST**

Component Group: Combustion Devices
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	FILTER		R001B225
	FILTER INTEGRITY	FILTER BRAZE JOINTS ARE INSPECTED TO VERIFY COMPLETE COVERAGE.	
	ASI SYSTEM CLEANLINESS	ASI SUBASSEMBLIES ARE CLEANED DURING MANUFACTURING AND PRIOR TO FINAL ASSEMBLY.	RL10001 RA1610-005
		AFTER BRAZING, THE PASSAGE PORTS AND ORIFICES ARE INSPECTED FOR BLOCKAGE DUE TO BRAZING MATERIAL.	RA1607-009
		DURING THE PROPELLANT CONDITIONING THE FUEL ASI SYSTEM IS PURGED TO MAINTAIN IT FREE OF MOISTURE AND ICE.	OMRSD SC0FB0 310 OMRSD SC0FR0 320
	PROPELLANT SYSTEM CLEANLINESS	SSME PROPELLANT SYSTEM IS DRIED AND VERIFIED DRY PRIOR TO EACH FLIGHT.	OMRSD V41CB0.080 OMRSD V41CB0.081
	ASSFMBLY INTEGRITY	THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY ASI INTEGRITY.	RL00050-04 RL00056-06 RL00056-07
		AN INSPECTION OF THE ASI CHAMBER AFTER EACH FLIGHT VERIFIES NO BLOCKAGE HAS OCCURRED DURING PREVIOUS OPERATION. (LAST TEST)	OMRSD V41BU0 040

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

Reference: NASA letter SA21/96/308 and Rocketdyne letter 88RC08781.

Operational Use: Not Applicable

**SSME FMEA/CIL
WELD JOINTS**

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

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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			