

**SSME FIRE/LOX  
REDUNDANCY SCREEN**

Component Group: Combustion Devices  
 CIL Item: A605-01  
 Part Number: R0017438  
 Component: Fuel Preburner (Phase II+)  
 FMEA Item: A605  
 Failure Mode: ASI fails to ignite

Prepared: A. Kay  
 Approved: T. Nguyen  
 Approval Date: 9/9/99  
 Change #: 2  
 Directive #: CCBD ME3-C1-5238

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Phase	Failure / Effect Description	Criticality
5 4.1	The fuel preburner gasses do not ignite, causing fuel pump speed to be below redline value. Mission scrub. Loss of vehicle due to LOX-rich operation may result if failure to establish fuel preburner ignition is not detected.	Hazard Reference 1R ME-FE6S
Redundancy Screens: FUEL PREBURNER SYSTEM - SENSOR SYSTEM: UNLIKE REDUNDANCY		
A: Pass - Redundant hardware items are capable of checkout during normal ground turnaround.		
B: Pass - Loss of a redundant hardware item is detectable during flight.		
C: Pass - Loss of redundant hardware items could not result from a single credible event.		

SSME / A/CIL  
DESIGN

Component Group: Combustion Devices  
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Design / Document Reference

**FAILURE CAUSE: A: Contamination which blocks fuel orifices or passages.**

THE FUEL IS FILTERED TO 400-MICRONS AT THE EXTERNAL TANK (1). THE FUEL ASI DELIVERY SYSTEM IS DESIGNED TO REMOVE ANY PARTICLES THAT MAY CAUSE PARTIAL OR TOTAL BLOCKAGE OF THE PASSAGES. A FILTER LOCATED AT THE HEAD OF THE DELIVERY SYSTEM REMOVES PARTICLES FROM THE FUEL THAT MAY BE LARGE ENOUGH TO CAUSE A REDUCTION IN FUEL FLOW (2). THE FILTER IS DESIGNED TO STOP PARTICLES IN THE FUEL AND ALLOW THEM TO SETTLE OFF THE FILTER FACE (3). 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 BEFORE EXHIBITING A REDUCTION IN ASI CHAMBER FUEL DELIVERY. A PRE-START HELIUM PURGE MINIMIZES THE POSSIBILITY OF ASI ICE BLOCKAGE. THE ASI FUEL FILTER IS FABRICATED FROM INCONEL 625 ALLOY WHICH WAS SELECTED ON THE BASIS OF ITS BRAZEABILITY, WELDABILITY, MACHINABILITY AND MATERIAL PROPERTIES (4). INCONEL 625 CAN BE BRAZED WITHOUT PLATING IN A CONTROLLED ATMOSPHERE. THE FUEL FILTER IS BRAZED IN EITHER HYDROGEN, ARGON AND HELIUM, HELIUM OR A VACUUM (5). THE PHASE II+ POWERHEAD ASI FUEL FILTER DESIGN IS IDENTICAL TO THAT USED ON THE PHASE II POWERHEAD AND ENGINE, AND 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 (6). THE ASI SYSTEM HAS BEEN DESIGN VERIFICATION TESTED FOR LOW PRESSURE IGNITION AND LOW MIXTURE RATIOS. THE PHASE II FLEET LEADER ASI FUEL FILTER WAS SUBJECT TO MICROSCOPIC AND PENETRANT INSPECTION ON TWO OCCASIONS WITHOUT DETECTING ANY ANOMALIES (7).

(1) ICD 13M15030; (2) RSD07004; (3) R0018225; (4) RSS-8571-10; (5) RA0107-010; (6) RL00532, CP320R00036; (7) MPR-85-309, MPR-85-0859

**FAILURE CAUSE: B: Contamination which blocks oxidizer orifices or passages.**

THE OXIDIZER SUPPLY IS FILTERED TO 800-MICRONS AT THE EXTERNAL TANK (1). THE OXIDIZER ASI DELIVERY SYSTEM IS DESIGNED TO REMOVE ANY PARTICLES THAT MAY CAUSE PARTIAL OR TOTAL BLOCKAGE OF THE PASSAGES. THE PHASE II+ OXIDIZER ASI SYSTEM IS IDENTICAL TO THAT USED ON THE PHASE II POWERHEAD. THE PHASE II ASI SYSTEM HAS BEEN DESIGN VERIFICATION TESTED FOR LOW PRESSURE IGNITION AND LOW MIXTURE RATIOS (2).

(1) ICD 13M15030; (2) RSS-305-19

**FAILURE CAUSE: ALL CAUSES**

THE ASI CAN OPERATE OVER A WIDE MIXTURE RATIO RANGE. PARTIAL BLOCKAGE OF PROPELLANT PASSAGES CAN STILL ALLOW TIMELY PROPELLANT IGNITION (1).

(1) RSS-305-19

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## SSME FMEA/CIL INSPECTION AND TEST

Component Group: Combustion Devices  
 CIL Item: A605-01  
 Part Number: R001743B  
 Component: Fuel Preburner (Phase II\*)  
 FMEA Item: A605  
 Failure Mode: ASI fails to ignite.

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A, B	FILTER		R0015225
	FUEL FILTER INTEGRITY	THE FILTER BRAZE JOINTS ARE VISUALLY INSPECTED TO VERIFY 100% ALL OY FILLETS	
	ASI SYSTEM CLEANLINESS	ASI SUBASSEMBLIES ARE CLEANED DURING MANUFACTURING AND PRIOR TO FINAL ASSEMBLY.	RL10001 RA0110-018
		AFTER BRAZING, THE PASSAGE PORTS AND ORIFICES ARE INSPECTED FOR BLOCKAGE DUE TO BRAZING MATERIAL.	RA1607-010
		THE FUEL ASI SYSTEM IS PURGED DURING PROPELLANT CONDITIONING TO MAINTAIN IT FREE OF MOISTURE AND ICE FORMATION.	OMRSD 500FB3.310 OMRSD 500FB3.320
	PROPELLANT SYSTEM CLEANLINESS	SSME PROPELLANT SYSTEM IS DRIED AND VERIFIED DRY PRIOR TO EACH FLIGHT.	OMRSD V41CB0.082 OMRSD V41CB0.083
ALL CAUSES	ASSEMBLY INTEGRITY	THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY CORRECT OPERATION.	RL00056-01 RL00056-02 RL00056-07
		ASI CHAMBERS ARE INSPECTED FOR DAMAGE PRIOR TO EACH LAUNCH (LAST TEST).	OMRSD V41 BU0.040

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)  
 Reference: NASA letter S421/88/303 and Rocketdyne letter 88RC09761

Operational Use: Not Applicable.

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**SSME FMEA/CIL  
WELD JOINTS**

Component Group: Combustion Devices  
 CIL Item: A605  
 Component: R0017438  
 Part Number: Fuel Preburner (Phase II-)  
 A605

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Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side No: Access	Critical Initial Flaw Size Not Detectable		Comments
						HCF	LCF	
FPB BODY	R0017426	1	EBW	I		X		
FPB BODY	R0017426	2	EBW	I	X			
FPB BODY	R0017426	3	EBW	I	X			
FPB FUEL CHAMBER	R0017435	1	GTAW	I	X	X	X	
FPB FUEL CHAMBER	R0017435	2	GTAW	I	X	X	X	
FPB INJECTOR	R0017438	1	EBW	II	X	X	X	
FPB INJECTOR	R0017438	2	EBW	II	X	X	X	
FPB INJECTOR	R0017438	3	GTAW	II	X			
FPB INJECTOR	R0017438	5	EBW	II	X	N/A	N/A	
FPB INJECTOR	R0017438	39	EBW	II	X	N/A	N/A	
FPB INJECTOR	R0017438	39	EBW	II	X	X	X	
FPB FUEL MANIFOLD	RS009029	7(OPT), 8(OPT)	GTAW	I		X	X	
FPB FUEL MANIFOLD	RS009029	11(OPT)	GTAW	I		X		
FPB FUEL MANIFOLD	RS009029	13(OPT)	GTAW	I		X		
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 ASI FUEL LINE	RS009525	1 PLC	GTAW	I	X			

SSME F A/CIL  
**FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE**

Component Group: Combustion Devices  
 Item Name: Fuel Preburner (Phase II+)  
 Item Number: A605  
 Part Number: R0317438

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Base Line Rationale	Variance	Change Rationale	Variant Dash Number
1. A605 NO RATIONALE EFFECTED	902 WELD OVERLAY EXISTS ON ONE PREBURNER ASSEMBLY.	OVERLAY WAS APPLIED TO PROVIDE HYDROGEN EMBRITTELEMENT PROTECTION. USE AS IS RATIONALE: ANALYSIS SHOWED NO HEE PROTECTION REQUIRED.	R0317438-51
2. A605-9,-10,-11. NO RATIONALE EFFECTED	POWERHEADS EXIST UTILIZING THE COMBINED FOUR ZONE PROOF PRESSURE TEST FROM THE HOT GAS MANIFOLD. CEI REQUIREMENTS ARE MAINTAINED.	HOT GAS MANIFOLD PROOF PRESSURE TEST ACCOMPLISHED SEPARATELY PRIOR TO COOLANT DUCT AND MAIN INJECTOR INSTALLATION.	R0019201-681, -701, -731 -991, 1051.

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