

**DDMC FMECA/CIL
REDUNDANCY SCREEN**

Component Group: Combustion Devices
 CIL Item: AB05-06
 Part Number: R0017439
 Component: Fuel Preburner (Phase II*)
 FMEA Item: A605
 Failure Mode: Oxidizer post crack.

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

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Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	A crack allows fuel flow into the oxidizer post passage resulting in post internal erosion and possible loss of post section into turbine flow stream and subsequent turbine blade failure. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE. N/A	1 MF-FR2S, ML-FB2M, ME-FB2A,C

**SSME / FA/CIL
DESIGN**

Component Group: Combustion Devices
CIL Item: A605-08
Part Number: R0017438
Component: Fuel Preburner (Phase II+)
FMEA Item: A605
Failure Mode: Oxidizer post crack.

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Design / Document Reference

FAILURE CAUSE: A: Parent material failure.

THE FUEL PREBURNER INJECTION ELEMENTS ARE FABRICATED FROM 304L CRES MATERIAL (1). THIS MATERIAL WAS SELECTED FOR ITS STRENGTH, BRAZABILITY, RESISTANCE TO HYDROGEN ENVIRONMENT EMBRITTLEMENT, AND RESISTANCE TO OXYGEN FLAMMABILITY (2). ALL MATERIALS ARE PROCURED PER SPECIFICATION REQUIREMENTS (3). THE PHASE II+ INJECTOR ELEMENTS FEATURE A COAXIAL DESIGN FABRICATED BY BRAZING AN OUTER FUEL SLEEVE TO AN INNER LOX POST WHICH EXTENDS THROUGH THE CENTER OF THE FUEL SLEEVE. THE PHASE II+ INJECTION ELEMENT UTILIZES A REDUCED LENGTH LOX POST DESIGNED TO PRECLUDE THE NEED FOR SUPPORT PINS. THE DESIGN ALSO FEATURES A FUEL SLEEVE WITH A REDUCED NUMBER OF INLET HOLES (AS COMPARED TO THE PHASE II CONFIGURATION) TO INCREASE ELEMENT FUEL FLOW AND LOWER ELEMENT FUEL RESISTANCE. THE PHASE II+ INJECTION ELEMENTS HAVE COMPLETED COMBUSTION CODE MODELING ANALYSIS AND LABORATORY COLD FLOW CALIBRATION TESTS TO VERIFY SATISFACTORY FLAME ZONE CHARACTERISTICS AND ELEMENT FUEL RESISTANCE AT ENGINE OPERATING CONDITIONS. STRUCTURAL ANALYSIS VERIFIED THE CAPABILITY OF THE PHASE II+ PREBURNER INJECTION ELEMENT DESIGN TO MEET ALL STRUCTURAL DESIGN AND LIFE REQUIREMENTS (4) INCLUDING: HIGH AND LOW CYCLE FATIGUE LIFE AND MINIMUM FACTORS OF SAFETY. THE PREBURNER ELEMENTS' PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/INDE FLAW GROWTH SINCE THEY CONTAIN NO FRACTURE CRITICAL PARTS (5). THE FUEL PREBURNER INJECTION ELEMENT LOX POSTS FROM ENGINE 0209 WERE EDDY CURRENT INSPECTED AFTER SUSTAINING 10,575.1 SECONDS AND 23 STARTS. THE INSPECTION REVEALED NO EVIDENCE OF MARTENSITIC TRANSFORMATION DUE TO WORK HARDENING. THE PREBURNER WAS DVR TESTED (6).

(1) R0017421; (2) RSS-8571-10; (3) CD-S-763; (4) VRS-0437; (5) CP120R0003R; (6) RSS-8878-1

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**SSME FMEA/CIL
INSPECTION AND TEST**

Component Group: Combustion Devices
 CIL Item: A605-06
 Part Number: R0017438
 Component: Fuel Preburner (Phase I+)
 FMEA Item: A605
 Failure Mode: Oxidizer post crack.

Prepared: A. Key
 Approved: T. Nguyen
 Approval Date: 9/9/99
 Change #: 1
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	PREBURNER INJECTION ELEMENT	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS	R0017421
	LOX POST BRAZE INTEGRITY	THE LOX POST TO FUEL SLEEVE FURNACE BRAZING IS INSPECTED FOR BRAZE FLOW AND DEFECTS PER SPECIFICATION REQUIREMENTS. THE LOX POST TO INTERPROPELLANT PLATE BRAZING IS INSPECTED PER SPECIFICATION REQUIREMENTS FOR BRAZE FLOW AND DEFECTS.	RA1607-004 RA1607-007
ALL CAUSES	ASSEMBLY INTEGRITY	LOX POST CONCENTRICITY IS VERIFIED PER DRAWING REQUIREMENTS. THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY LOX POST INTEGRITY. THE PREBURNER IS BORESCOPE INSPECTED PRIOR TO EACH FLIGHT FOR DAMAGE (LAST TEST).	R0017421 R0017438 RL00050-04 RL00056-05 RL00056-07 OMRSD V415110 0-0

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
 Reference: NASA letter SA21/88/308 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

Prepared: A. Kay
 Approved: T. Nguyen
 Approval Date: 9/9/99
 Change #: 1
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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

Prepared: A. Kay
 Approved: T. Nguyen
 Approval Date: 9/8/99
 Change #: 2
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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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