SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group:	Combustion Devices	Prepared:	A. Kay
CIL Item:	A605-04	Approved:	T. Nguyen
Part Number:	R0017438	Approval Date:	9/9/99
Component:	Fuel Preburner (Phase II+)	Change #:	2
FMEA Item:	A605	Directive #:	CCBD ME3-01-5238
Failure Mode:	Non-uniformity of fuel flow in the injection element occurs.	Page:	1 of 1

Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Significant non-uniformity causes local high mixtures and recirculation of gases around the elements periphery which causes local erosion of the injection element lip, injector faceplate, combustion zone liner or injector baffle. Erosion through the liner may result in burn-through of the structural wall. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A	1 ME-FB25 ME FB2M, ME F32A,C

SSME FMEA/CIL
DESIGN

Component Group:	Combustion Devices	Prepared:	A. Kay
CIL Item:	A505-04	Approved:	T. Nguyen
Part Number:	R0017438	Approval Date:	9/9/99
Component:	Fuel Preburner (Phase II+)	Change #:	2
FMEA Item:	A505	Directive #:	CCBD ME3-01-5238
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Design / Document Reference

FAILURE CAUSE: A: Contamination in the fuel annulus.

THE FUEL IS FILTERED TO 400-MICRONS AT THE EXTERNAL TANK (1). THE PREBURNER INJECTION ELEMENT (2) CONSISTS OF A FUEL SLEEVE ENCIRCLING A LOX POST WITH THE TWO BRAZED TOGETHER COAXIAL OUTER FUEL SLEEVE AND INNER LOX POST. THE GAP BETWEEN THE LOX POST AND THE FUEL SLEEVE IS CONTROLLED (2) (3). THE FUEL PASSAGE IS FED BY A SERIES OF SMALL HOLES EQUALLY SPACED AROUND THE EXTERNAL SLEEVE IN STAGGERED ROWS. THE HOLES ARE SMALLER IN DIAMETER THAN THE ANNULUS DIMENSIONS. THIS SYSTEM ACTS AS A FILTER FOR THE ANNULUS. THE PHASE II+ INJECTOR ELEMENT DESIGN FEATURES A REDUCED NUMBER OF FUEL SLEEVE HOLES OVER THE PHASE II DESIGN. THE FUEL SLEEVE HOLE DIAMETERS ARE IDENTICAL FOR BOTH INJECTOR CONFIGURATIONS RESULTING IN A DESIGN WHICH IS EQUALLY TOLERANT TO CONTAMINATION AS THE PHASE II CONFIGURATION. THE PREBURNER INJECTOR ELEMENT HAS BEEN DESIGN VERIFICATION TESTED FOR ELEMENT CONTAMINATION (4). INSPECTIONS OF THE PREBURNERS IN ENGINE 2010 REVEALED NO CONTAMINATION IN THE FUEL ANNULUS (5). THE PHASE II+ FUEL PREBURNER HAS BEEN DVR TESTED (4).

(1) ICD-13M15003; (2) R0017421; (3) R0017438; (4) RSS-8879. (5) MFR-86-0137

FAILURE CAUSE: B: Non-concentric posts.

TOLERANCES ON THE ELEMENT ASSEMBLY DRAWING ALONG WITH SUBSEQUENT ASSEMBLY REQUIREMENTS CONTROL CONCENTRICITY OF THE POSTS (1). INSPECTIONS OF THE PREBURNERS IN ENGINE 2010 REVEALED NO PROBLEMS WITH CONCENTRICITY (2)(3)(4)

(1) R0017421 (2) RL00050-01; (3) MPR-86-0137; (4) RLC0573

SSME FM CIL
INSPECTION AND TEST

Component Group:	Combustion Devices	**Prepared:**	A. Kay
CIL Item:	A605-04	**Approved:**	T. Nguyen
Part Number:	R0017438	**Approval Date:**	9/9/99
Component:	Fuel Preburner (Phase II+)	**Change #:**	2
FMEA Item:	A605	**Directive #:**	CCBD ME3-01-5236
Failure Mode	Non-uniformity of fuel flow in the injection element occurs	**Page:**	1 of 1

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	PREBURNER INJECTOR ELEMENT		R0017421
	CLEANLINESS	POSTS ARE CLEANED PER SPECIFICATION REQUIREMENTS.	RA0110-018
		AFTER BRAZING THE POST ARE INSPECTED FOR BLOCKAGE.	RA1607-004
		THE FUEL ASI SYSTEM IS PURGED DURING PROPELLANT CONDITIONING TO MAINTAIN IT FREE OF MOISTURE AND ICE FORMATION.	OMRSD S00FB0.31C OMRSD S00F90.32C
		UPSTREAM COMPONENTS ARE VERIFIED CLEAN TO FUEL SERVICE PER SPECIFICATION REQUIREMENTS.	RL10001
		ASSEMBLY IS VERIFIED CLEAN PER DRAWING AND SPECIFICATION REQUIREMENTS	R0017436 RA0110-018
	PROPELLANT SYSTEM CLEANLINESS	SSME PROPELLANT SYSTEM IS DRIED AND VERIFIED DRY PRIOR TO EACH FLIGHT	OMRSD V41CBC.08Z OMRSD V41CBC.08S
B	PREBURNER INJECTOR ELEMENT		R0017421
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS	
		AFTER BRAZING THE POSTS ARE INSPECTED FOR PROPER POSITIONING PER DRAWING AND SPECIFICATION REQUIREMENTS.	R0017438 RA1607-004 RA1607-007
		POST CONCENTRICITY IS CHECKED EVERY TIME THE HPFTP IS REMOVED, PER TIME CYCLE REQUIREMENTS.	OMRSD V41BU0.091C
ALL CAUSES	ASSEMBLY INTEGRITY	THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY PREBURNER INTEGRITY.	RL00056-04 RL00056-05 RL00056-07
		THE PREBURNER IS BORESCOPE INSPECTED PRIOR TO EACH FLIGHT FOR DAMAGE (LAST TEST).	OMRSD V41BU0.04C

Failure History Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
Reference: NASA letter SA21/58/208 and Rocketdyne letter 88RC09761.

Operational Use: Not Applicable

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
Directive #: CCBD ME3-01-5238

Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side No Access	Critical Initial Flaw Size Not Detectable HCF	LCF	Comments
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	Ib	X	X	X	
FPB INJECTOR	R0017438	2	EBW	II	X	X	X	
FPB INJECTOR	R0017438	3	GTAW	II	X			
FPB INJECTOR	R0017438	9	EBW	II	X	N/A	N/A	
FPB INJECTOR	R0017438	38	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: 9/9/99
Change #: 2
Directive #: CCBD ME3-01 5238

Base Line Rationale	Variance	Change Rationale	Variant Dash Number
1. A605 NO RATIONALE EFFECTED	903 WELD OVERLAY EXISTS ON ONE PREBURNER ASSEMBLY.	OVERLAY WAS APPLIED TO PROVIDE HYDROGEN EMBRITTLEMENT 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.	R0019001-681, -701, -731 -991, 1051.