

SSME FA/CIL  
REDUNDANCY SCREEN

Component Group: Combustion Devices  
CIL Item: A705-04  
Part Number: R0017440  
Component: Oxidizer Preburner (Phase II+)  
FMEA Item: A705  
Failure Mode: Non-uniformity of fuel flow in the injection element occurs.

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

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Phase	Failure / Effect Description	Criticality
SMU 4.	Significant non-uniformity can cause local high mixtures and recirculation of gases at the element periphery which might cause 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.	Hazard Reference 1 MC F365, ME-FEEM, MC FDOA C
Redundancy Screens: SINGLE POINT FAILURE N/A		

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SSME FMEA/CIL  
DESIGN

Component Group: Combustion Devices  
CIL Item: A705-04  
Part Number: R0017440  
Component: Oxidizer Preburner (Phase II+)  
FMEA Item: A705  
Failure Mode: Non-uniformity of fuel flow in the injection element occurs.

Prepared: A. Kay  
Approved: T. Nguyen  
Approval Date: 9/8/99  
Change #: 1  
Directive #: CGBD 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 EN CIRCLING A LOX POST WITH THE TWO BRAZED TOGETHER. 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 SYSTEMS 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. INSPECTIONS OF THE PREBURNERS IN ENGINE 0209 REVEALED NO CONTAMINATION IN THE FUEL ANNULUS (5). THE PHASE II+ OXIDIZER PREBURNER INJECTOR HAS BEEN DFR TESTED (4).

(1) ICD 13M15000; (2) R0017429; (3) R0017440; (4) RSS-8879; (5) MPR-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) R0017429; (2) RL00050-04; (3) MPR-86-0137; (4) RL00573

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**SSME FMF MIL  
INSPECTION AND TEST**

Component Group: Combustion Devices  
 CIL Item: A705-04  
 Part Number: R0017440  
 Component: Oxidizer Preburner (Phase II+)  
 FMEA Item: A705  
 Failure Mode: Non-uniformity of fuel flow in the injection element occurs.

Prepared: A. Kay  
 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	OPB PREBURNER INJECTION ELEMENT		R0017429
	CLEANLINESS	POSTS ARE CLEANED PER SPECIFICATION REQUIREMENTS.	RA0110-010
		AFTER BRAZING THE POSTS ARE INSPECTED FOR BLOCKAGE PER SPECIFICATION REQUIREMENTS.	RA1607-004
		ASSEMBLY IS VERIFIED CLEAN PER DRAWING AND SPECIFICATION REQUIREMENTS.	R0017440 RA0110-018
		UPSTREAM COMPONENTS ARE VERIFIED CLEAN TO FUEL SERVICE PER SPECIFICATION REQUIREMENTS.	RL10001
	PROPELLANT SYSTEM CLEANLINESS	THE FUEL ASI SYSTEM IS PURGED DURING PROPELLANT CONDITIONING TO MAINTAIN IT FREE OF MOISTURE AND ICE FORMATION.  SSME PROPELLANT SYSTEM IS DRIED AND VERIFIED DRY PRIOR TO EACH FLIGHT.	OMRSD 500FB0.310 OMRSD 500FB0.320  OMRSD V41CB0.082 OMRSD V41CB0.083
B	PREBURNER INJECTOR ELEMENT		R0017429
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	
	ASSEMBLY INTEGRITY	AFTER BRAZING THE POSTS ARE INSPECTED FOR PROPER POSITIONING PER DRAWING AND SPECIFICATION REQUIREMENTS.  POST CONCENTRICITY IS CHECKED EVERY TIME THE HPOTP IS REMOVED, PER TIME CYCLE REQUIREMENTS.	R0017440 RA1607-004 RA1607-007  OMRSD V41BU0.050
ALL CAUSES	ASSEMBLY INTEGRITY	THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY PREBURNER INTEGRITY.  THE PREBURNER IS BORESCOPE INSPECTED PRIOR TO EACH FLIGHT FOR DAMAGE. (LAST TEST)	RL00055-04 RL00055-06 RL00055-07  OMRSD V41BU0.040

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

Reference: NASA letter SA2188/305 and Rockwell letter 88RC09761.

Operational Use: Not Applicable.

**SSME FA/CIL  
WELD JOINTS**

Component Group: Combustion Devices  
 CIL Item: A706  
 Component: R0017440  
 Part Number: Oxidizer Preburner (Phase II\*)  
 A706

Prepared: A. Kay  
 Approved: T. Nguyen  
 Approval Date: 6/9/99  
 Change #: 1  
 Directive #: CCBD ME3-01-6238  
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Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical initial Flaw Size Not Detectable		Comments
						HCF	LCF	
OPB FUEL CHAMBER	R0017425	1	GTAW	I,II	X	X	X	
OPB FUEL CHAMBER	R0017425	2	GTAW	II	X	X	X	
OPB INJECTOR	R0017440	1	FRW	Ib	X	X	X	
OPB INJECTOR	R0017440	2	EBW	II	X	X	X	
OPB INJECTOR	R0017440	3	GTAW	II	X	X	X	
OPB INJECTOR	R0017440	9	EBW	II	X	N/A	N/A	
OPB INJECTOR	R0017440	28	EBW	II	X	N/A	N/A	
OPB INJECTOR	R0017440	29	EBW	II	X	X	X	
OPB INJECTOR	R0017440	31	GTAW	II	X			
OPB BODY	R0018067	1	GTAW	II	X	X	X	
OPB BODY	R0018067	2	EBW	I	X			
OPB BODY	R0018067	6	GTAW	II	X			
OPB BODY	R0018067	7	GTAW	II	X			
OPB FUEL MANIFOLD	RS009013	9(OPT), 10(OPT)	GTAW	I		X	X	
OPB FUEL MANIFOLD	RS009013	11(OPT)	GTAW	I		X	X	
OPB FUEL MANIFOLD	RS009013	13(OPT)	GTAW	I	X			
OPB OXID INLET	RS009014	6-8	GTAW	I		X		
OPB ASI FUEL LINE	RS009024	1	GTAW	I	X	X	X	

**SSME FMEA/CIL**

**FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE**

Component Group: Combustion Devices  
Item Name: Oxidizer Preburner (Phase II+)  
Item Number: A705  
Part Number: R0017449

Prepared: A. Kay  
Approved: T. Nguyen  
Approval Date: 9/9/99  
Change #: 2  
Directive #: CCBD ME3 01-5238

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Base Line Rationale	Variance	Change Rationale	Variation Dash Number
1. A705-09, -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.	R0018001-691, -701, 731, 991, -1051.

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