

~~SSWIC FMEA/CIL~~
REDUNDANCY SCREEN

Component Group: Combustion Devices
CIL Item: A705-06
Part Number: R0017440
Component: Oxidizer Preburner (Phase II+)
FMEA Item: A705
Failure Mode: Oxidizer post cracks.

Prepared: A. Kay
Approved: T. Nguyen
Approval Date: 9/9/99
Change #: 1
Directive #: CCBD MEJ-01-523R

Page: 1 of 1

Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	A crack allows fuel to 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	ME-FBSS, ME-FBEM, ME-FBGA C

SSME / A/CIL
DESIGN

Component Group: Combustion Devices
CIL Item: A705-06
Part Number: R0017440
Component: Oxidizer Preburner (Phase II+)
FMEA Item: A705
Failure Mode: Oxidizer post cracks.

Prepared: A. Kay
Approved: T. Nguyen
Approval Date: 9/9/98
Change #: 1
Directive #: CCBD ME3-01-5238

Page: 1 of 1

Design / Document Reference

FAILURE CAUSE: A: Parent material failure.

THE OXIDIZER 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 FLAMEABILITY (2). ALL MATERIALS ARE PROCURED PER SPECIFICATION REQUIREMENTS (3). THE PHASE II+ INJECTION 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 ELEMENT 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/DE FLAW GROWTH SINCE THEY CONTAIN NO FRACTURE CRITICAL PARTS (5). THE OXIDIZER 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) R0017429 (2) RSS-8571-10; (3) QQ-S-753; (4) VRS-0487; (5) NASA TASK 117; (6) RSS-8879-

A - 318

**SSME FMEA/CIL
INSPECTION AND TEST**

Component Group: Combustion Devices
 CIL Item: A705-08
 Part Number: R0017440
 Component: Oxidizer Preburner (Phase II+)
 FMEA Item: A705
 Failure Mode: Oxidizer post cracks.

Prepared: A. Kay
 Approved: T. Nguyen
 Approval Date: 9/8/99
 Change #: 1
 Directive #: CCBD ME3-01-5238

Page: 1 of 1

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	OPR INJECTION ELEMENT		R0017429
	LOX POST MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	
	LOX POST BRAZE INTEGRITY	THE LOX POST TO FUEL SLEEVE FURNACE BRAZING IS INSPECTED FOR BRAZE FLOW AND DEFECTS PER SPECIFICATION REQUIREMENTS.	RA1607-004
		THE LOX POST TO INTERPROPELLANT PLATE BRAZING IS INSPECTED PER SPECIFICATION FOR BRAZE FLOW AND DEFECTS.	RA1607-007
ACT CAUSES	ASSEMBLY INTEGRITY	LOX POST CONCENTRICITY IS VERIFIED PER DRAWING REQUIREMENTS.	R0017429 R0017440
		THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY LOX POST INTEGRITY	RL00056-04 RL00055-06 RL00056-07
		THE PREBURNER IS BORESCOPE INSPECTED PRIOR TO EACH FLIGHT FOR DAMAGE (LAST TEST).	OMRSD V4-BU0.040

A - 319

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
 Reference: NASA letter SA21/98/309 and Rocketdyne letter 89RC09761.
 Operational Use: Not Applicable.

**SSME EA/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
 Page: 1 of 1

A - 341

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: R0017443

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

Page: 1 of 1

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.	R00-2001-691, -701, 731, 991, -1051.

A - 342