

SSMIC FMEA/CIL
REDUNDANCY SCREEN

Component Group: Combustion Devices
CIL Item: A705-09
Part Number: R0017440
Component: Oxidizer Preburner (Phase II+)
FMEA Item: A705
Failure Mode: Interpropellant plate or element-to-plate braze joint leakage.

Prepared: A. Kay
Approved: T. Nguyen
Approval Date: 9/9/99
Change #: 2
Directive #: CC80 ME3-01-5238

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Phase	Failure / Effect Description
SMC 4.1	Ignition of the mixed propellants at the leakage point causes erosion and/or ice production within the manifold having the lowest pressure. Contamination by ice or injector face erosion causes propellant maldistribution and burnout of turbines and other components within or downstream of the combustion chamber. Loss of vehicle.

Redundancy Screens: SINGLE POINT FAILURE: N/A

Criticality
Hazard Reference
1
ME-FBCC,
ME-FBGM
ME-FB6A,C

SSME A/CIL
DESIGN

Component Group: Combustion Devices
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Part Number: R0017440
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Design / Document Reference

FAILURE CAUSE: A: Braze joint or interpropellant plate failure.

THE PHASE II+ OPB INJECTION ELEMENTS ARE FABRICATED FROM 304L GRES WHICH IS RESISTANT TO HYDROGEN EMBRITTLMENT AND OXYGEN FLAMEABILITY (1). IT HAS GOOD BRAZEBILITY, AND IS CONDUSIVE TO CREATING HIGH INTEGRITY BRAZE BONDS. THE INTERPROPELLANT PLATE IS FABRICATED FROM INCONEL 625. INCONEL 625 WAS SELECTED FOR ITS BRAZEABILITY AND MACHINABILITY. INCONEL 625 IS DUCTILE AT CRYOGENIC TEMPERATURES AND IS LOX COMPATIBLE. THE FACEPLATE IS SUFFICIENTLY DUCTILE AND SUBJECTED TO MINOR STRAIN LEVELS MAKING IT STABLE IN A HYDROGEN ENVIRONMENT (*). CLOSE TOLERANCES ON THE ELEMENTS AND FACEPLATE ARE HELD TO INSURE SATISFACTORY BRAZE BONDING (2)(3). THE BRAZING OPERATION IS CONTROLLED BY SPECIFICATION REQUIREMENTS (4). PREBURNERS ARE SCREENED FOR BOTH FABRICATION AND CUTOFF POP RELATED FACEPLATE DEFORMATION BY VERIFYING FACEPLATE FLATNESS IN ACCORDANCE WITH SPECIFICATION REQUIRMENTS (5). PRIMARY STRESS FACTORS OF SAFETY MEET CEI REQUIREMENTS (6). HIGH CYCLE FATIGUE LIFE AND LOW CYCLE FATIGUE LIFE MEET CEI REQUIREMENTS (7). THE INTERPROPELLANT PLATE'S PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/IDE FLAW GROWTH SINCE IT CONTAINS NO FRACTURE CRITICAL PARTS (8). THE FMEA/CIL WELDS ARE CLEARED FOR FRACTURE MECHANICS/IDE FLAW GROWTH BY THE WFLD ASSESSMENT (9). TABLE A705 LISTS ALL FMEA/CIL WELDS AND IDENTIFIES THOSE WELDS IN WHICH THE CRITICAL INITIAL FLAW SIZE IS NOT DETECTABLE AND THOSE WELDS IN WHICH THE ROOT SIDE IS NOT ACCSSIBLE FOR INSPECTION. THOSE WELDS IN WHICH THE CRITICAL INITIAL FLAW SIZE IS NOT DETECTABLE ARE ACCEPTABLE FOR FLIGHT BY RISK ASSESSMENT (9). THE PREBURNER WAS DVR TESTED (10).

(1) RSS-8571-10; (2) R0017423; (3) R0017429; (4) RA1607-007, RA1607-017; (5) RL03350-04 RL00626; (6) RSS-8646 CP320R0003B; (7) RL00532, CP320R0003B; (8) NASA TASK 117; (9) RSS-8755; (10) RSS-8879.

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**SSME FMEA/CIL
INSPECTION AND TEST**

Component Group: Combustion Devices
 CIL Item: A705-09
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 FMEA Item: A705
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	OPB INJECTION ELEMENT INTERPROPELLANT PLATE BAFFLE PIN		RC017429 RS009008 RS009026
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RS009008 RC017429 RS009026
		THE INTERPROPELLANT PLATE IS ULTRASONICALLY INSPECTED BEFORE MACHINING PER SPECIFICATION REQUIREMENTS.	RA0115-012
		THE INTERPROPELLANT PLATE IS PENETRANT INSPECTED BEFORE AND AFTER MACHINING PER SPECIFICATION REQUIREMENTS.	RA0115-116
	WELD INTEGRITY	ALL WELDS ARE INSPECTED TO DRAWING AND SPECIFICATION REQUIREMENTS PER WELD CLASS. INSPECTIONS INCLUDE: VISUAL, DIMENSIONAL, PENETRANT, RADIOGRAPHIC, ULTRASONIC, AND FILLER MATERIAL, AS APPLICABLE.	RL00311 RA1807-071 RA0115-116 RA0115-005 RA0115-127 RA1115-001
	BRAZE INTEGRITY	THE BRAZING OPERATION IS CONTROLLED BY SPECIFICATION REQUIREMENTS AND THE ALLOY IS TRACEABLE TO CERTIFICATIONS.	RA1807-007 RBC170-160
		THE BAFFLES ARE FLOW CHECKED AFTER BRAZING PER SPECIFICATION REQUIREMENTS.	RL00558
	ASSEMBLY INTEGRITY	ASSEMBLY JOINTS ARE LEAK CHECKED, PENETRANT INSPECTED AND INSPECTED VISUALLY AFTER BRAZING TO INSURE 360 DEGREES OF ALLOY FILLET.	RC017440 RA1807-007 RAC115-116
		THE INJECTOR ASSEMBLY IS PRESSURE TESTED AFTER BRAZING, WELDING, AND INSTALLATION.	RC018001 RL00846
		PREBURNER INJECTOR FACEPLATE FLATNESS IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RC018023 RL00526
		THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY ASSEMBLY INTEGRITY.	RL00050-04 RL00056-05 RL00056-07

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA).
 Reference: NASA letter SA21/88/308 and Rocketdyne letter 92RC09761.
 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
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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

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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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