SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group:	Combustion Devices	**Prepared:**	A. Kay
CIL Item	A705-12	**Approved:**	T. Nguyen
Part Number:	R0017440	**Approval Date:**	9/9/99
Component:	Oxidizer Preburner (Phase II+)	**Change #:**	1
FMEA Item:	A705	**Directive #:**	CCBD ME3-97-5228
Failure Mode:	Omega joint failure	**Page:**	1 of 1

Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Loss of the joint causes oxidizer-rich operation across the injector face and turbine failure. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A	1 ME-FRSS, ME-FR6M ME-FREA,C

SSME FMEA/CIL
DESIGN

Component Group:	Combustion Devices
CIL Item:	A705-12
Part Number:	R0017440
Component:	Oxidizer Preburner (Phase II+)
FMEA Item:	A705
Failure Mode:	Omega joint failure.

Prepared:	A. Kay
Approved:	T. Nguyen
Approval Date:	3/9/99
Change #:	1
Directive #:	CCBD ME3-01-5216
Page:	1 of 1

Design / Document Reference

FAILURE CAUSE: A: Weld or parent material failure.

THE OXIDIZER PREBURNER EXPANSION OMEGA JOINT IS FABRICATED FROM INCONEL 625. INCONEL 625 WAS SELECTED ON THE BASIS OF ITS WELDABILITY, MACHINABILITY, AND MATERIAL PROPERTIES (1). THE JOINT IS NOT SUSCEPTABLE TO HYDROGEN EMBRITTLEMENT DUE TO LOW OPERATING STRAINS. THE EXPANSION JOINT CONSISTS OF AN INTERNAL AND EXTERNAL RING CONNECTED BY A U-CHANNEL (2). THIS DESIGN ALLOWS RELATIVE MOVEMENT BETWEEN THE RINGS DUE TO RADIAL AND AXIAL EXPANSION OF THE INJECTOR FACEPLATE. THE EFFECT OF SMALL LEAKAGE AT THE EXPANSION JOINT IS NOT DETRIMENTAL IN VIEW OF THE AMOUNT OF FUEL THAT IS PASSED THROUGH THE FACEPLATE AND BEHIND THE LINER (3). HIGH CYCLE FATIGUE, LOW CYCLE FATIGUE LIFE, AND THE MINIMUM FACTORS OF SAFETY MEET CEI REQUIREMENTS (4). THE EXPANSION JOINT PARENT MATERIAL WAS CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH SINCE IT CONTAINS NO FRACTURE CRITICAL PARTS (5). THE FMEA/CIL WELDS ARE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH BY THE WELD ASSESSMENT (6). 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 ACCESSIBLE FOR INSPECITON. THOSE WELDS IN WHICH THE CRITICAL INITIAL FLAW SIZE IS NOT DETECTABLE ARE ACCEPTABLE FOR FLIGHT BY RISK ASSESSMENT (6). THE PHASE II+ OXIDIZER PREBURNER WAS DVR TESTED (7).

(1) RSS-8571-10 (2) RS009032; (3) R001592; (4) RL00532, CP320R0003B, RSS-8546; (5) NASA TASK 117; (6) RSS-8756; (7) RSS-8879-1

SSME FM CIL
INSPECTION AND TEST

Component Group:	Combustion Devices	Prepared:	A. Kay
CIL Item:	A705-12	Approved:	T. Nguyen
Part Number:	R0017440	Approval Date:	9/9/99
Component:	Oxidizer Preburner (Phase II+)	Change #:	1
FMEA Item:	A705	Directive #:	CCBD ME3-01-5238
Failure Mode:	Omega joint failure.	Page:	1 of 1

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	EXPANSION JOINT		RS0C2032
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS	
		EXPANSION JOINT IS PENETRANT INSPECTED AFTER COMPLETION PER SPECIFICATION REQUIREMENTS.	R40115-116
	WELD INTEGRITY	ALL WELDS ARE INSPECTED TO DRAWING AND SPECIFICATION REQUIREMENTS PER WELD CLASS. INSPECTIONS INCLUDE: VISUAL, DIMENSIONAL, AS APPLICABLE.	RL10011 RA1607-071
		TEST SAMPLE WELDS ARE MADE FOR R0018020 WELDS 7 AND 8 TO VERIFY WELD PROCESS CONTROL AND GEOMETRY	RA1607-071
	ASSEMBLY INTEGRITY	THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY OMEGA JOINT INTEGRITY	RL00050-04 RL00056-06 RL00056-07
		THE INJECTOR FACE IS INSPECTED PRIOR TO EACH LAUNCH (LAST TEST).	OMRSD V41BU0.040

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
Reference: NASA letter SA21/88/308 and Rocketdyne letter 88RC03751.

Operational Use: Not Applicable

SSME EA/CIL
WELD JOINTS

Component Group: Combustion Devices
CIL Item: A705
Component: R0017440
Part Number: Oxidizer Preburner (Phase II+)
A706

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 Not Access	Critical nitial Flaw Size Not Detectable HCF	LCF	Comments
OPB FUEL CHAMBER	R0017425	1	GTAW	I,II	X	X	X	
OPB FUEL CHAMBER	R0017425	2	GTAW	I,II	X	X	X	
OPB INJECTOR	R0017440	1	EBW	IIb	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	RS009524	1	GTAW	I	X	X	X	

SSME FMEA/CIL
FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE

Component Group:	Combustion Devices	**Prepared:**	A. Kay
Item Name:	Oxidizer Preburner (Phase II+)	**Approved:**	T. Nguyen
Item Number:	A705	**Approval Date:**	9/9/99
Part Number:	R0017449	**Change #:**	2
		Directive #:	CCBD ME3 01-5238
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Base Line Rationale	Variance	Change Rationale	Variant 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.