

SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group: Combustion Devices
CIL Item: A200-03
Part Number: RS039122
Component: Main Injector
FMEA Item: A200
Failure Mode: Blockage of one LOX ASI passage.

Prepared: A. Kay
Approved: T. Nguyen
Approval Date: 9/9/99
Change #: 2
Directive #: CGBD ME3 01 523B

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Phase	Failure / Effect Description	Criticality Hazard Reference
SVC 41	Blockage of one LOX ASI injection passage causes localized LOX-rich operation, erosion of the ASI combustion chamber walls, manifold invasion, injector burnout and aft compartment overpressurization and fire. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A	MF-R4S, ME-B4A,C, ME-B4M

SSMEL ACIL
DESIGN

Component Group: Combustion Devices
CIL Item: A200-03
Part Number: RS009122
Component: Main Injector
FMEA Item: A201
Failure Mode: Blockage of one LOX ASI passage.

Prepared: A. Kay
Approved: T. Nguyen
Approval Date: 8/9/99
Change #: 2
Directive #: CCBD MES-01-523B

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Design / Document Reference

FAILURE CAUSE: A: Contamination of the ASI LOX Injection passage.

THE MAIN INJECTOR ASI OXIDIZER INLET LINE HAS ORIFICES WELDED UPSTREAM OF THE LOX PASSAGE (1). THE ORIFICES WILL NOT PASS PARTICLES WHICH ARE LARGE ENOUGH TO BLOCK THE PASSAGES WITHIN THE ASI (2). ANY CONTAMINATION WHICH COULD CAUSE BLOCKAGE WOULD HAVE TO BE IN THE APPROXIMATELY 14 INCHES OF LINE BELOW THE ORIFICE PRIOR TO WELDING (1). HOT FIRE TESTING OF THE ENGINE WILL REVEAL BLOCKAGE PROBLEMS PRIOR TO FLIGHT USE (3).

(1) RS009126; (2) RS003038; (3) RL00050-04

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SSME FMEA/CIL
INSPECTION AND TEST

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	ASI SYSTEM CLEANLINESS	ASI SUBASSEMBLIES ARE CLEANED DURING MANUFACTURING AND PRIOR TO FINAL ASSEMBLY	RT 10031 RA1510-003
		AFTER BRAZING, THE PASSAGE PORTS AND GRIFICES ARE INSPECTED FOR BLOCKAGE DUE TO BRAZING MATERIAL.	RA1507-009
		DURING THE PROPELLANT CONDITIONING THE OXIDIZER ASI SYSTEM IS PURGED TO MAINTAIN IT FREE OF MOISTURE AND ICE.	OMRSD S00FB0 300
	PROPELLANT SYSTEM CLEANLINESS	SSME PROPELLANT SYSTEM IS DRIED AND VERIFIED DRY PRIOR TO EACH FLIGHT.	OMRSD V410B0 080 OMRSD V410B0 081
	ASSEMBLY INTEGRITY	THE HOT FIRE TESTING AND 2ND E 5 M INSPECTIONS VERIFY ASI INTEGRITY.	RL00056-04 RL00056-05 RL00056-07
		THE ASI CHAMBERS ARE INSPECTED FOR DAMAGE PRIOR TO EACH LAUNCH (LAST TEST)	OMRSD V41B00 029

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Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
 Reference: NASA letter SA2118B/208 and Rocketdyne letter 86RC09761.
 Operational Use: Not Applicable

SSME / A/CIL
WELD JOINTS

Component Group: Combustion Devices
 CIL Item: A200
 Component: RS009122
 Part Number: Main Injector
 A200

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Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial		Comments
						Flaw Size Not	Detectable	
						HCF	LCF	
MAIN INJECTOR ASI	RSC09061	3	GTAW	I		X	X	
MAIN INJECTOR ASI	RSC09061	5	GTAW	I		X	X	
MAIN INJECTOR	RS009126	1	EBW	I				
MAIN INJECTOR	RS009126	6,7,52,53	GTAW	I	X	X	X	
MAIN INJECTOR	RS009126	8	EBW	I		X		
MAIN INJECTOR	RS009126	9	EBW	I	X			
MAIN INJECTOR	RS009126	10	EBW	II	X	X	X	
MAIN INJECTOR	RS009126	12,13	GTAW	I	X			
MAIN INJECTOR	RS009126	14,15	GTAW	I	X	X	X	
MAIN INJECTOR	RS009126	16,17	GTAW	I		X	X	
MAIN INJECTOR	RS009126	20	GTAW	I	X			
MAIN INJECTOR	RS009126	21	GTAW	II	X			
MAIN INJECTOR	RS009126	22	GTAW	I	X			
MAIN INJECTOR	RS009126	23-25,54	GTAW	I	X			
MAIN INJECTOR	RS009126	44,45	GTAW	I		X	X	
MAIN INJECTOR	RS009126	50,51	EBW	Ia	X	X	X	
MAIN INJECTOR	RS009126	59	EBW	I,b	X			
MAIN INJECTOR	RS009126	60,61	GTAW	II	X	X		
INLET SHELL	RSD08235	1 LFT	EBW	I				
INLET SHELL	RSC08235	1 RHT	EBW	I		X	X	
INLET SHELL	RSC05237	600 FLCS	FRW	I	X			

**SSME FMEA/CIL
FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE**

Component Group: Combustion Devices
Item Name: Main Injector
Item Number: A200
Part Number: R5009122

Prepared: A. Kay
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Change #: 1
Directive #: CCDD ME3-01-5238

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Base Line Rationale	Variance	Change Rationale	Variant Dash Number
1. A200-07 LOX ASI SLEEVE BRAZE IS X-RAYED AND BORESCOPEO (ECP 697)	NO BORESCOPE INSPECTION.	VISUAL VERIFICATION GAVE ADDITIONAL CONFIDENCE THAT BRAZING HAS NOT CREATED LIQUID METAL EMBRITTLEMENT. USE AS IS RATIONALE: 1. ALL SLEEVES ARE X-RAYED, WHICH SPECIFICALLY INSPECTS FOR LIQUID METAL EMBRITTLEMENT CRACKING; 2. JOINT SUSCEPTIBILITY IS LOW (NO STRAIN ON TUBE DURING WELDING, BRAZE MUST FLOW ONLY TO WITNESS HOLE).	-741, -751, -771, -761, -791, -801.
2. A200-06 WALL THICKNESS OF SECONDARY FACEPLATE RETAINERS INCREASED ON OUTER THREE ROWS. (ECP 634)	PREVIOUS CONFIGURATION HAD A THINNER WALL.	THICKER WALLS GAVE ADDITIONAL LOX POST SUPPORT IN THE HIGH FLOW AREAS. USE AS IS RATIONALE: 1. HIGH FLOW AREA POSTS WERE PLUGGED AND RODDED FOR ADDITIONAL SUPPORT; 2. LIFE LIMIT ON THE MAIN INJECTOR LOX POSTS PREVENTS DAMAGE LEVELS FROM EXCEEDING ALLOWABLE LIMITS. (DAR 1373)	-771
3. A200-06 EDDY CURRENT INSPECTION ON ALL LOX POST INERTIA WELDS. (ECP 342)	NO EDDY CURRENT INSPECTION OF INERTIA WELDS.	EDDY CURRENT INSPECTION PROVIDE ADDITIONAL CONFIDENCE IN INTERNAL WELD INTEGRITY. USE AS IS RATIONALE: 1. INERTIA WELDS ARE CONTROLLED BY SPECIFICATION; 2. NO FAILURE HISTORY WITH HAYNES 188 POSTS; 3. SURFACE FINISH IS CONTROLLED TO REDUCE STRESS CONCENTRATIONS; 4. ROW 13 POSTS ARE DYE PENETRANT INSPECTED ON O.D	-791, -751, -771, -781, -791, -801, -811, -851.
4. A200-07 ELIMINATION OF BRAZE JOINTS OF ASI INLET TUBE TO BIFED TIRES	BRAZED PREVIOUS CONFIGURATION	ELIMINATION OF BRAZE JOINT ELIMINATES THE POSSIBILITY OF LIQUID METAL EMBRITTLEMENT. USE AS IS RATIONALE: 1. BRAZE JOINTS ARE DONE WITHOUT INDUCED LOADS 2. NO RESIDUAL STRESSES IN TUBES. 3. SECTIONED HARDWARE SHOWS NO PROBLEMS	-741, -771, -781.
5. A200-07 SPLITTER VANE GEOMETRY IS VERIFIED PER CURRENT DRAWING REQUIREMENTS. (ECP 989R1)	SPLITTER VANE GEOMETRY DOES NOT MEET CURRENT DRAWING REQUIREMENTS.	RE-DESIGN OF THE SPLITTER VANE ALTERED THE STRUCTURAL RESPONSE OF THE VANES TO FLOW, ELIMINATING FLOW INDUCED CRACKING. USE AS IS RATIONALE: 1. ENGINES NOT MEETING CURRENT SPLITTER VANE DRAWING REQUIREMENTS ARE SCREENED AT GREEN RUN TO IDENTIFY THOSE EXHIBITING THE 4 KHz RESPONSE. THESE ENGINES ARE REWORKED TO CURRENT DRAWING REQUIREMENTS. RE-PRESSURE TESTED AND RE-IDENTIFIED.	-1021, -1141, -1161, -1171, -1201, -1301, -1311, -1321, -1361, -1441

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