

SSME / A/CIL
REDUNDANCY / SCREEN

Component Group: Combustion Devices
CIL Item: A200-05
Part Number: RS009122
Component: Main Injector
FMEA Item: A200
Failure Mode: Partial blockage of an oxidizer orifice.

Prepared: A. Kay
Approved: T. Nguyen
Approval Date: 9/9/99
Change #: 2
Directive #: CCRD ME3-01-5238
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Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Partial blockage allows combustion gas backflow into the post causing combustion within the post and post burn-through. Extensive subsequent erosion results in aft compartment overpressurization and fire. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A	ME-B4S, ME-B4A,C, ME-B4M

**SSME FMEA/CIL
DESIGN**

Component Group: Combustion Devices
CIL Item: A200-05
Part Number: RS009122
Component: Main Injector
FMEA Item: A209
Failure Mode: Partial blockage of an oxidizer orifice

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Design / Document Reference

FAILURE CAUSE: A: Local contamination in oxidizer manifold.

THE OXIDIZER IS FILTERED TO 800-MICRONS AT THE EXTERNAL TANK (1). THE INJECTOR IS DESIGNED TO MINIMIZE PLUGGING POTENTIAL BY SIZING THE ORIFICE AND FLOW PASSAGES AS LARGE AS PRACTICAL. PRE-START PURGE MINIMIZES THE POSSIBILITY OF RESTRICTION IN THE OXIDIZER SYSTEM DUE TO ICE FORMATION. HOT FIRING HAS BEEN PERFORMED WITH PARTIAL POST BLOCKAGE AND THERE WAS NO EFFECT ON POST OR PERFORMANCE.

(1) ICD 13M15003

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**SSME FM OIL
INSPECTION AND TEST**

Component Group: Combustion Devices
 CIL Item: A200-05
 Part Number: RS009122
 Component: Main Injector
 FMEA Item: A200
 Failure Mode: Partial blockage of an oxidizer orifice.

Prepared: A. Kay
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	MAIN INJECTOR ASSEMBLY		RS009122
	OXIDIZER SYSTEM CLEANLINESS	INJECTOR ASSEMBLY IS VAPOR DEGREASED. ALL SURFACES ARE FLUSHED, AND INSPECTED TO INSURE NO ADHERING PARTICLES. INJECTOR FLOW TESTING VERIFIES ORIFICES ARE FREE FROM OBSTRUCTIONS. MAIN INJECTOR IS ALTERNATELY FORWARD AND BACKWARD FLUSHED.	RS009237 RA0110-045 RL00527 RA1610-016
		MAIN INJECTOR ASSEMBLY UNDERGOES A FINAL INSPECTION FOR CLEANLINESS AND MUST BE IN ACCORDANCE WITH THE REQUIREMENTS FOR OXYGEN SYSTEM SERVICE.	RS009122 RA1610-005 RL10001
		ALL UPSTREAM COMPONENTS ARE INSPECTED FOR CLEANING TO LOX SERVICE OR BETTER REQUIREMENTS.	RL10001
		INJECTOR IS INSPECTED FOR WATER AND CONTAMINATION AFTER EACH FLIGHT.	OMRSD V41030.050
	PROPELLANT SYSTEM CLEANLINESS	SSME PROPELLANT SYSTEM IS DRIED AND VERIFIED DRY PRIOR TO EACH FLIGHT.	OMRSD V41080.050 OMRSD V41080.051
	ASSEMBLY INTEGRITY	THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY ORIFICE INTEGRITY. AFTER EACH FLIGHT THE MAIN INJECTOR FACEPLATE, BAFFLES, AND LOX POSTS ARE INSPECTED FOR SIGNS OF DAMAGE OR OVERHEATING HARDWARE. (LAST TEST)	RI 00050-04 RI 00056-06 RI 00056-07 OMRSD V41000.029

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Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA) Reference: NASA letter SA21/30/308 and Rockwell letter 88RC08761.
 Operational Use: Not Applicable.

SSME / A/CIL
WELD JOINTS

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

Prepared: A. Kay
 Approved: T. Nguyen
 Approval Date: 9/9/99
 Change #: 1
 Directive #: CCBD ME3-01-523A
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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	RSD05235	1 LFT	EBW	I				
INLET SHELL	RSC09235	1 RHT	EBW	I		X	X	
INLET SHELL	RSC05237	600 FLCS	FRW	I	X			

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**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
Approved: I. Nguyen
Approval Date: 9/8/99
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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