

SINGLE POINT FAILURE
REDUNDANCY SCREEN

Component Group: Combustion Devices
 CIL Item: A050-03
 Part Number: RS007010
 Component: Powerhead
 FMEA Item: A050
 Failure Mode: Shell or propellant duct rupture.

Prepared: A. Kay
 Approved: T. Nguyen
 Approval Date: 9/9/99
 Change #: 1
 Directive #: CCBD ME3-01-8238

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Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	External fuel or hot-gas leak. Overpressurization of aft compartment. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A	1 ME-B1S, ME-B1A,C, ME-B1M

SSME FMEACIL
DESIGN

Component Group: Combustion Devices
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Failure Mode: Shell or propellant duct rupture

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Design / Document Reference

FAILURE CAUSE: A: Weld/parent material failure.

THE HOT-GAS MANIFOLD STRUCTURAL SHELLS ARE MADE FROM INCONEL 718. MECHANICAL PROPERTIES OF INCONEL 718 ARE DEGRADED BY EXPOSURE TO HYDROGEN AT TEMPERATURE ABOVE -100 DEGREES F UNDER PLASTIC STRAIN. STRUCTURAL ANALYSIS OF THE STRUCTURAL SHELL INDICATES THAT THE MAXIMUM STRAINS ARE BELOW YIELD AND HYDROGEN ENVIRONMENT EMBRITTLEMENT PROTECTION FOR THE PARENT MATERIAL IS NOT NEEDED (1). ALL INCONEL 718 WELD JOINTS IN CONTACT WITH CH₂ (WITH EXCEPTION TO THE HOT-GAS MANIFOLD CENTERLINE WELDS AND THE CHAMBER BODY TO HOT-GAS MANIFOLD WELD) ARE PROTECTED FROM HYDROGEN ENVIRONMENT EMBRITTLEMENT WITH A WELD OVERLAY OF INCOLOY 903 OR INCOLOY 85. THE EXCEPTION WELDS DO NOT REQUIRE HYDROGEN ENVIRONMENT EMBRITTLEMENT PROTECTION DUE TO LOW STRESSES. THE CHAMBER BODY TO HOT-GAS MANIFOLD WELD IS DESIGNED FOR LOW STRAIN IN THE HYDROGEN REGION AND IS MACHINED TO MAINTAIN A 63 MICROFINISH FOR ADDITIONAL HYDROGEN ENVIRONMENT EMBRITTLEMENT PROTECTION (2). ANALYSIS OF THE HOT GAS MANIFOLD STRUCTURAL SHELL SHOWS THAT CEI PRIMARY FACTORS OF SAFETY ARE MET (3). CEI FATIGUE LIFE REQUIREMENTS ARE MET FOR THE STRUCTURAL SHELL (4). THE POWERHEAD DUCTS ARE MADE FROM INCOLOY 903. THIS ALLOY IS RESISTANT TO HIGH-PRESSURE HYDROGEN ENVIRONMENT EMBRITTLEMENT, THEREFORE HYDROGEN ENVIRONMENT EMBRITTLEMENT PROTECTION IS NOT REQUIRED FOR THE POWERHEAD DUCTS. IT IS SEMI-CORROSION RESISTANT AND EXHIBITS GOOD RESISTANCE TO STRESS-CORROSION CRACKING (5). ANALYSIS OF THE POWERHEAD DUCTS SHOWS THAT CEI PRIMARY FACTORS OF SAFETY ARE MET (3). POWERHEAD DUCTS ARE LIFE LIMITED BY MAJOR WAIVER (6). THE MANIFOLD DUCTS PARENT MATERIAL WAS CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH SINCE THEY ARE NOT FRACTURE CRITICAL PARTS, EXCEPT FOR THE FUEL AND OXIDIZER CHAMBER ASSEMBLIES, HEAT EXCHANGER BOWL, AND HOT GAS MANIFOLD SHELLS WHICH WERE CLEARED BY CRITICAL INITIAL FLAW SIZE DETECTABILITY (7). THE FMEACIL WELDS ARE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH BY THE WELD ASSESSMENT (8). TABLE A350 LISTS ALL FMEACIL 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 INSPECTION. THOSE WELDS IN WHICH THE CRITICAL INITIAL FLAW SIZE IS NOT DETECTABLE ARE ACCEPTABLE FOR FLIGHT BY RISK ASSESSMENT (8). EXTERNAL PENETRANT INSPECTION OF THE SHELLS AND WELDS ON ENGINE 2010 DURING DISASSEMBLY SHOWED NO ANOMALIES. DISASSEMBLY OF ENGINE 2010 REVEALED SHRINKAGE CRACKS STARTING AT THE ELECTRON BEAM SEAL WELD BETWEEN THE INJECTOR AND BODY, AND ENDING IN THE PARENT MATERIAL OF THE INCONEL 718 BODY (9). ME & T ANALYSIS REVEALED NO FATIGUE GROWTH. STRUCTURAL ANALYSIS OF THIS AREA USING WORST CASE ASSUMPTIONS (i.e. EXPOSURE TO HYDROGEN) SHOWS THE WORST POSSIBLE DEFECT TO BE ACCEPTABLE. THE POWERHEAD ASSEMBLY HAS COMPLETED CVS TESTING (10).

(1) RSS-8581-9; (2) ECP 824; (3) RSS-8646, CP320RC003B; (4) RL00532, CR32CRC003B; (5) RSS-8582-6; (6) DAR 2062 DAR 2088; (7) NASA TASK 117; (8) RSS-8756; (9) MPR 86 0684; (10) CVS-101

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**SSME FMEA/CIL
INSPECTION AND TEST**

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Failure Causes	Significant Characteristics	Inspection(s) / Tests	Document Reference
A	OPB CHAMBER ASSY FFB CHAMBER ASSY HEX BOWL HCM SHELL SHELL HEX ASSEMBLY		RS009003 RS009019 RS009802 RS007051 RS007070 RS007071 RS006801
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS	RB0170-153 RB0170-155 RB0170-185 RB0170-211 RB0170-212
	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.	RL10011 RA0507-094 RA0115-116 RA0115-006 RA0115-127 RA1115-001
		FUEL PREBURNER CHAMBER WELD NO. 5 (OR OPTIONAL WELD NO. 11) OD GEOMETRY IS VERIFIED PER DRAWING REQUIREMENTS.	RS009019 RS009029 ECP 968
		ALL FORGING DETAILS ARE ULTRASONIC INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-012
		INNER SURFACES OF MANIFOLD SHELL ARE PENETRANT INSPECTED AFTER ETCH PER SPECIFICATION REQUIREMENTS.	RA0115-119
		THE EXTERIOR OF RS008902 HEX BOWL & RS007071 MANIFOLD ARE PENETRANT INSPECTED AFTER MACHINING PER SPECIFICATION REQUIREMENTS.	RA0115-115
		MANIFOLD HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS	RA0011-020
		RS009019 & RS009003 PREBURNER CHAMBERS ARE PROOF PRESSURE TESTED PRIOR TO WELDING INTO HOT-GAS MANIFOLD.	RS009019 RS009003
		SPECIAL INSPECTIONS ARE PERFORMED ON RS007051 WELDS 41 AND 42 (BORING, ETCH, PLUG WELDING).	RL00455

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A	Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
		MANIFOLD DUCTS		RS007036, R0010748, RS007034, RS007022, RS009147, RS009148, RS007007, RS007017, RS007030, RS007049
		DUCTING MATERIAL INTEGRITY	THE INCOLOY 603 DUCTING PIECES AND FLANGE ARE MAGNETIC PARTICLE OR PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS. INCONEL 718 DUCTING PIECES AND FLANGE ARE PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS. INCONEL 718 FORGINGS AND CASTINGS ARE EITHER X-RAYED OR ULTRASONICALLY INSPECTED FOR INTERNAL DEFECTS, PER SPECIFICATION REQUIREMENTS. HEAT TREAT OF THE DUCTING IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0115-115 RA0115-116 RA0115-116 RA0115-006 RA0115-012 RA0611-020
		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.	RL10011 RA0007-094 RA0115-116 RA0115-006 RA0115-127 RA1115-001
		ASSEMBLY INTEGRITY	POWERHEAD DUCTING IS PROOF PRESSURE TESTED PER SPECIFICATION REQUIREMENTS. HOT-GAS MANIFOLDS PROOF PRESSURE TESTED PER SPECIFICATION REQUIREMENTS. ALL EXTERNAL WELDS ARE PENETRANT INSPECTED AFTER PROOF PRESSURE TESTING PER DRAWING AND SPECIFICATION REQUIREMENTS. THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY MANIFOLD INTEGRITY. HELIUM SIGNATURE TEST PERFORMED PRIOR TO EACH FLIGHT VERIFIES HGM WALL HAS NOT RUPTURED. (LAST TEST)	RL00177 RL00241 RS007010 RS007051 RA0115-115 RL00050-04 RL00056-06 RL00056-07 OMRSD 30000-550

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
Failure History:	Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA) Reference: NASA letter SA2109/303 and Rocketdyne letter 88RCC9761.		
Operational Use:	Not Applicable		

**SSME / A/CIL
WELD JOINTS**

Component Group: Combustion Devices
 CIL Item: A050
 Component: RS007010
 Part Number: Powerhead
 A050

Prepared: A. Kay
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Component	Basic Part Number	Weld Number	Weld Type	Class	Access	Critical Initial Flaw Size Not Detectable		Comments
						Root Side Not	LCF	
OPB INLET ELBOW	R0010749	1	GTAW	I		X		(A700)
OPB INLET ELBOW	R0010749	4	GTAW	I		X		(A700)
OPB INLET ELBOW	R0010749	5	GTAW	I		X	X	(A700)
OPB INLET ELBOW	R0010749	6	GTAW	I	X	X	X	(A700)
OPB INLET ELBOW	R0010749	7(OPT)	GTAW	I		X		(A700)
OPB INLET ELBOW	R0010749	8(OPT)	GTAW	I		X		(A700)
OPB INLET ELBOW	R0010749	9	GTAW	I		X	X	(A700)
OPB INLET ELBOW	R0010749	10	GTAW	I	X	X	X	(A700)
OPB INLET ELBOW	R0010749	11(OPT)	GTAW	I		X	X	(A700)
OPB INLET ELBOW	R0010749	12(OPT)	GTAW	I		X		(A700)
FUEL PREBURNER LINER	RC011054	1(OPT)	FBW	I		X	X	(A600)
FUEL PREBURNER LINER	RC011054	1(OPT)	GTAW	I		X	X	(A600)
FUEL PREBURNER LINER	RC011054	2(OPT)	GTAW	I		X	X	(A600)
FUEL PREBURNER LINER	RC011054	2(OPT)	ERW	I				(A600)
OXIDIZER PREBURNER LINER	R0011582	1(OPT)	GTAW	I		X		(A700)
OXIDIZER PREBURNER LINER	R0011582	1(OPT)	ERW	I		X		(A700)
OXIDIZER PREBURNER LINER	R0011582	2(OPT)	ERW	I		X		(A700)
OXIDIZER PREBURNER LINER	R0011582	2(OPT)	GTAW	I		X		(A700)
OXIDIZER PREBURNER LINER	R0011582	2-17	GTAW	II				(A700)
POWERHEAD	RS007010	1	GTAW	I	X	X		
POWERHEAD	RS007010	2A(OPT)	GTAW	II	X			
POWERHEAD	RS007010	2B(OPT)	GTAW	II	X			
POWERHEAD	RS007010	3	GTAW	I				
POWERHEAD	RS007010	4	GTAW	I	X			
POWERHEAD	RS007010	5	GTAW	I	X			
POWERHEAD	RS007010	6	GTAW	I	X			
POWERHEAD	RS007010	7	GTAW	I	X			
POWERHEAD	RS007010	12	GTAW	I	X	X		
POWERHEAD	RS007010	13	GTAW	I		X	X	
POWERHEAD	RS007010	14	GTAW	I	X			
POWERHEAD	RS007010	15	GTAW	I	X			

Component Group: Combustion Devices
 CIL Item: A050
 Component: RS007010
 Part Number: Powerhead
 A050

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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	
POWERHEAD	RS007010	16	GTAW	I		X	X	
POWERHEAD	RS007010	17	GTAW	I		X	X	
POWERHEAD	RS007010	18	GTAW	I	X	X	X	
POWERHEAD	RS007010	21	EBW	I	X			
POWERHEAD	RS007010	22	GTAW	I	X			
POWERHEAD	RS007010	23	GTAW	II	X			
POWERHEAD	RS007010	32	GTAW	II	X	X	X	(A700)
CPB FUEL SUPPLY DUCT	RS007012	2	GTAW	I				
CPB FUEL SUPPLY DUCT	RS007012	3	GTAW	I		X	X	
CPB FUEL SUPPLY DUCT	RS007012	6	GTAW	I		X		
CPB FUEL SUPPLY DUCT	RS007012	7	GTAW	I	X	X		
CPB FUEL SUPPLY DUCT	RS007012	8	GTAW	I		X		
CPB FUEL SUPPLY DUCT	RS007012	9	GTAW	I		X	X	(A150)
PREBURNER FUEL SUPPLY DUCT	RS007030	1,2	GTAW	I				(A150)
OXID TANK PRESSURANT DUCT	RS007049	1	GTAW	I				(A150)
OXID TANK PRESSURANT DUCT	RS007049	2	GTAW	I			X	(A150)
OXID TANK PRESSURANT DUCT	RS007049	3	GTAW	I				
HOT GAS MANIFOLD	RS007051	13,14	EBW	II	X	X	X	
HOT GAS MANIFOLD	RS007051	15,16	EBW	II	X	X	X	(A600)
HOT GAS MANIFOLD	RS007051	17-24	GTAW	II	X		X	
HOT GAS MANIFOLD	RS007051	29-40	GTAW	II	X			
HOT GAS MANIFOLD	RS007051	41	EBW	II	X			
HOT GAS MANIFOLD	RS007051	42	EBW	II	X	X		
HOT GAS MANIFOLD	RS007051	43,44	EBW	III	X	X	X	
HOT GAS MANIFOLD	RS007051	48,51	GTAW	II	X			
HOT GAS MANIFOLD	RS007051	62,70	GTAW	I	X	X	X	(A700) (A600)
HOT GAS MANIFOLD	RS007051	64	GTAW	I	X	X	X	(A700)
HOT GAS MANIFOLD	RS007051	73	GTAW	I	X	X	X	(A600)
HOT GAS MANIFOLD	RS007051	80,81,147	EBW	II	X	X	X	
HOT GAS MANIFOLD	RS007051	83,84	GTAW	II	X			
HOT GAS MANIFOLD	RS007051	86,87	GTAW	II	X			
HOT GAS MANIFOLD	RS007051	101	EBW	Ib	X	X		
HOT GAS MANIFOLD	RS007051	113-124	GTAW	II	X			
HOT GAS MANIFOLD	RS007051	133	GTAW	II	X	X		

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Component : Combustion Devices
 CIL Item: A050
 Component: RS007010
 Part Number: Powerhead
 A050

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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	
HOT GAS MANIFOLD	RS007051	134	GTAW	II	X			
HOT GAS MANIFOLD	RS007051	135,136,156	GTAW	I,II	X			
HOT GAS MANIFOLD	RS007051	139-141	GTAW	I		X	X	(A700)
HOT GAS MANIFOLD	RS007051	142-144	GTAW	I		X	X	(A500) (A700)
HOT GAS MANIFOLD	RS007051	145-146	EBW	I				
HOT GAS MANIFOLD	RS007051	148	EBW	I	X	X		
HOT GAS MANIFOLD	RS007051	149	GTAW	I	X	X	X	
FUEL LINER	RS007064	3(OPT)	EBW	I				
FUEL LINER	RS007064	3(OPT)	GTAW	I				
FUEL LINER	RS007065	3(OPT)	EBW	I				
FUEL LINER	RS007065	3(OPT)	GTAW	I				
FUEL LINER	RS007065	4(OPT)	GTAW	II				
FUEL LINER	RS007065	4(OPT)	EBW	II				
FUEL LINER	RS007065	8	GTAW	II	X			
FUEL LINER	RS007065	9	GTAW	II	X			
FUEL LINER	RS007065	10	GTAW	II	X			
FUEL LINER	RS007065	18(OPT)	GTAW	II	X			
FUEL LINER	RS007065	19	GTAW	II	X			
FUEL LINER	RS007065	20	GTAW	II	X			
FUEL LINER	RS007065	21	GTAW	II	X			
FUEL LINER	RS007065	22	GTAW	II	X			
FUEL LINER	RS007065	23	GTAW	II				
FUEL LINER	RS007065	24	GTAW	II				
OXIDIZER LINER	RS007066	2(OPT)	GTAW	II	X			
OXIDIZER LINER	RS007066	2(OPT)	EBW	II	X			
OXIDIZER HGM STRUC SHELL	RS007070	3(OPT)	EBW	I				
OXIDIZER HGM STRUC SHELL	RS007070	4	GTAW	I	X			
OXIDIZER HGM STRUC SHELL	RS007070	5(OPT)	EBW	I		X	X	
OXIDIZER HGM STRUC SHELL	RS007070	28(OPT)	GTAW	II	X			
OXIDIZER HGM STRUC SHELL	RS007070	31,32(OPT)	GTAW	I	X			
OXIDIZER HGM STRUC SHELL	RS007070	33(OPT)	GTAW	II	X			
FUEL HGM STRUC SHELL	RS007071	1	EBW	I		X		
FUEL HGM STRUC SHELL	RS007071	3,4,5	GTAW	II	X	X	X	
FUEL HGM STRUC SHELL	RS007071	7	GTAW	I				

Component Group: Combustion Devices
 CIL Item: A050
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 Part Number: Powerhead
 A050

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Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Nmt Access	Critical Initial Flaw Size Not Detectable		Comments
						HCF	LCF	
FUEL HGM STRUC SHELL	RS007071	38,39,46,48	EBW	I	X	X	X	
FPB HGM COOLANT DUCT	RS007094	2	GTAW	I		X		
FPB HGM COOLANT DUCT	RS007094	3	GTAW	I			X	
CPB HGM COOLANT DUCT	RS007097	2	GTAW	I		X		

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SSME FAILURE

FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE

Component Group: Combustion Devices
 Item Name: Powerhead
 Item Number: A050
 Part Number: R5307010

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Base Line Rationale	Variance	Change Rationale	Variant Dash Number
1. A050-03 FORGING DETAILS ARE ULTRASONIC INSPECTED PER RA0115-12. (FCF 680)	SOME DETAILS PREVIOUSLY ULTRASONIC INSPECTED PER MIL-STD-2154	ROCKETDYNE QA CONTROL OF REQUIREMENT INTERPRETATIONS IS INCREASED. USE AS IS RATIONALE. MIL SPEC IS ESSENTIALLY THE SAME AS ROCKFODYNE SPEC EXCEPT ROCKFODYNE SPEC IS CLEARER.	-612, -1071, -1211, -1241, -1291, -1331, -1311, -1401, -1421, 1431.
2. A050-03 ALL WELDS ARE INSPECTED TO DRAWING AND SPECIFICATION REQUIREMENTS PER WELD CLASS.	PRE-WELD FIT UP DIMENSION AND 100% PENETRATION WAS NOT VERIFIED ON CLASS II WELDS 3 AND 5.	MEASUREMENT ASSURED THAT WELDER COMPLETELY FUSED JOINT, REDUCING LIKELIHOOD OF SIGNIFICANT WELD DEFECTS. VISUAL INSPECTION OF WELD ROOTS PROVIDED ADDITIONAL CONFIDENCE THAT NO GROSS WELD DEFECTS EXIST AND THAT FULL PENETRATION IS ACHIEVED. USE AS IS RATIONALE: 1. STRUCTURAL ANALYSIS OF WORST-CASE CONDITION INDICATES THAT ALL PRIMARY FACTORS OF SAFETY ARE MAINTAINED FOR UP TO 55% LACK OF PENETRATION 2. ALL UNITS INSPECTED EXHIBITED 35% LACK OF PENETRATION OR BETTER (LESS THAN 35%). 3. SEM ANALYSIS OF SECTIONED UNIT 2010 WHICH HAD ACCUMULATED 65 STARTS AND 19,903 SECONDS EXHIBITED NO CRACK GROWTH AT LACK OF PENETRATION SITE. 4. THERE HAVE BEEN NO IN-SERVICE FAILURES OF THIS JOINT IN THE ENTIRE SSME HISTORY.	-311, -341, -351, -361, -371, -381, -391, -401, -421, -431, -441, -451, -451, -471, -481, -491, -501, -511
3. A050-03 POWERHEAD UNIT CLOSE OUT WELDS ARE INSPECTED TO DRAWINGS SPECIFICATION REQUIREMENTS.	RADIOGRAPHIC QUALITY IS NOT IN COMPLIANCE WITH 2-2T SENSITIVITY LEVEL II VERIFICATION PER RA0115 006, REV E, PARA 3 B & 3.14	PENETRIMETERS VERIFY THE SENSITIVITY OF AN X-RAY SHOT THE USAGE OF THE WRONG PENETRIMETER REDUCES THE ASSURANCE OF THIS INSPECTION BUT DOES NOT MEAN THE INSPECTION WAS WITHOUT VALUE. USE AS IS RATIONALE 1. ALL FLIGHT POWERHEADS HAVE BEEN FABRICATED USING A MIXED PENETRIMETER SENSITIVITY WITH NO WELD FAILURES OVER 1500 MAINSTAGE STARTS AND 530,000 SECONDS OF HOTFIRE EXPERIENCE. THE FLEET LEADERS HAVE ACCUMULATED 117 MAINSTAGE STARTS (PH 2105/EO213) AND 49,423 SECONDS (PH 4002, EO218) OF HOTFIRE EXPERIENCE 2. AS A MEASURE OF CONFIDENCE, A SINGLE FLIGHT RELIABILITY ANALYSIS SHOWED A 98/96 LIFE OF 66 STARTS/22,000 SECONDS BASED ON 43 UNITS. 3. SEVERAL INSPECTIONS ARE PERFORMED ON THE WELDS IN ADDITION TO RADIOGRAPHIC WHICH INCLUDES A VISUAL INSPECTION, PENETRANT INSPECTION, A POWERHEAD PROOF TEST, AND A LEAK CHECK WITH A SUBSEQUENT PENETRANT INSPECTION 4. WELD JOINTS 1, 5, 6, 7, AND 12 HAVE HIGH ULTIMATE FACTORS OF SAFETY (>2.5) AND HAVE EMBEDDED GFS GREATER THAN THE TYPICAL 0.80" WELD PASS.	-2431, -2441, -2451, -2461, -2471, -2481, -2501, -2571, -2581, -2601, -2611, -2621, -2641, -2701, -2721, -2761, -2921

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