SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group: Fuel Turbopumps
CIL Item: B200-20
Component: High Pressure Fuel Turbopump
Part Number: RS007501
Failure Mode: Excessive coolant flow.

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 4/21/99
Change #: 1
Directive #: CCBD ME3-01-5206
Page: 1 of 1

Phase	Failure / Effect Description	Criticality Hazard Reference
S 4 1	Rise in coolant liner pressure. Excess rise in coolant liner pressure would result in a premature engine shutdown. Mission scrub if detected by redline. Loss of vehicle due to HPFTP failure may result if not detected. Redundancy Screens TURBOPUMP SYSTEM - SENSOR SYSTEM: UNLIKE REDUNDANCY A: Pass - Redundant hardware items are capable of checkout during normal ground turnaround. B: Pass - Loss of a redundant hardware items is detectable during flight. C: Pass - Loss of redundant hardware items could not result from a single credible event.	1R ME-D1S,M
M 4 1	Rise in coolant liner pressure. Excess rise in coolant liner pressure would result in a premature engine shutdown. Mission abort if detected by redline. Loss of vehicle due to HPFTP failure may result if not detected. Redundancy Screens: TURBOPUMP SYSTEM - SENSOR SYSTEM: UNLIKE REDUNDANCY A: Pass - Redundant hardware items are capable of checkout during normal ground turnaround. B: Pass - Loss of a redundant hardware items is detectable during flight C Pass - Loss of redundant hardware items could not result from a single credible event.	1R ME-D1S,M

SSME FMEA/CIL
DESIGN

Component Group:	Fuel Turbopumps	Prepared:	D. Early
CIL Item:	B200-20	Approved:	T. Nguyen
Component:	High Pressure Fuel Turbopump	Approval Date:	4/21/99
Part Number:	RS007501	Change #:	1
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Design / Document Reference

FAILURE CAUSE: A: Leakage of main housing to lift-off seal static seal.

A PRESSURE-ASSISTED STATIC SEAL (1) IS PILOTED IN A GROOVE IN THE TURBOPUMP HOUSING (2) BETWEEN THE HOUSING AND LIFT-OFF SEAL FLANGE (3) TO PREVENT HYDROGEN LEAKAGE INTO THE TURBINE AND THE COOLANT LINER CIRCUIT. THE SEAL IS MANUFACTURED UTILIZING INCONEL 718 BAR AND IS SILVER PLATED WITH AN UNDERCOAT OF GOLD. THE INCONEL 718 PROVIDES STRENGTH AND DUCTILITY IN THE CRYOGENIC ENVIRONMENT (4). THE MATERIAL IS SOLUTION TREATED AND AGE-HARDENED. THE GOLD UNDERCOAT PROTECTS THE INCONEL 718 FROM HYDROGEN ENVIRONMENT EMBRITTLEMENT. THE SILVER PLATING PERMITS CONFORMANCE OF THE SEAL NOSE TO MINOR IRREGULARITIES IN THE MATING SURFACE. DESIGN ANALYSIS SHOWS WITH THE WORST COMBINATION OF TOLERANCES ADEQUATE SEAL COMPRESSION WOULD BE MAINTAINED OVER THE FULL RANGE OF POSSIBLE DEFLECTIONS.

(1) RD261-3015; (2) RS007577, RS007566; (3) R0019230; (4) RSS-8560-10

FAILURE CAUSE: B: Separation of lift-off seal to turbine labyrinth seal interface.
C: Excessive loss of bolt preload.

THE LIFT-OFF SEAL HOUSING (1) IS MANUFACTURED UTILIZING AN A-286 CRES FORGING (2). THIS MATERIAL WAS SELECTED FOR ITS COMPRESSIVE STRENGTH, RESISTANCE TO HIGH-PRESSURE HYDROGEN DEGRADATION, AND MECHANICAL PROPERTIES AT CRYOGENIC TEMPERATURES. THE MATERIAL IS SOLUTION TREATED AND AGE-HARDENED. THE TURBINE HUB LABYRINTH SEAL (3) IS MANUFACTURED UTILIZING AN INCONEL 718 FORGING (2). THIS MATERIAL WAS SELECTED FOR ITS CRYOGENIC DUCTILITY, STRENGTH, RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING, AND ITS PROPERITES ARE NOT DEGRADED IN A CRYOGENIC HYDROGEN ENVIRONMENT (2). THE MATERIAL IS SOLUTION TREATED AND AGE-HARDENED. A SCALLOPED CHANNEL MACHINED ON THE HUB LABYRINTH SEAL FLANGE FORMS A COOLANT ANNULUS, WHEN INTERFACED WITH THE LIFT-OFF SEAL. COOLANT ENTERS THIS MAINFOLD VIA 4 HOLES DOWNSTREAM OF THE FIRST LABYRINTH STEP AT THE SEAL HUB. THE COOLANT DISCHARGES FROM THIS MANIFOLD VIA 12 HOLES IN THE LIFT-OFF SEAL FLANGE AND ENTERS THE COOLANT LINER BY 12 HOLES IN THE MAIN HOUSING (4). A PRESSURE-ASSISTED STATIC SEAL (5) IS PILOTED IN A GROOVE ON THE TURBINE HUB LABYRINTH SEAL AT THE LIFT-OFF SEAL INTERFACE. THIS SEAL PRECLUDES DIRECT LEAKAGE OF THE HIGH PRESSURE HYDROGEN UPSTREAM OF THE LABYRINTHS, INTO THE COOLANT MANIFOLD. THE SEAL IS MANUFACTURED FROM INCONEL 718 WHICH PROVIDES THE REQUIRED STRENGTH AND DUCTILITY IN THE CRYOGENIC ENVIRONMENT (2). THE MATERIAL IS SOLUTION TREATED AND AGE-HARDENED. THE SEAL IS GOLD PLATED TO PROTECT THE BASE MATERIAL FROM HYDROGEN ENVIRONMENT EMBRITTLEMENT AND ALSO IMPROVES THE SEALING CAPABILITY. THE LIFT-OFF SEAL STACK IS ATTACHED TO THE HOUSING UTILIZING 12 A-286 CRES STRETCH BOLTS (5) AND 321 CRES CUPWASHERS (7). A-286 CRES WAS SELECTED FOR ITS RESISTANCE TO HIGH-PRESSURE HYDROGEN DEGRADATION, ITS MECHANICAL PROPERTIES AT CRYOGENIC TEMPERATURES, AND RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING (2). THE MATERIAL IS SOLUTION TREATED AND AGE-HARDENED. 321 CRES WAS SELECTED FOR ITS DUCTILITY, RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING, AND INSENSITIVITY TO HYDROGEN ENVIRONMENT EMBRITTLEMENT (2). THE MATERIAL IS ANNEALED TO IMPROVE MECHANICAL PROPERTIES, AND THE CUPWASHERS ARE YIELDED PRIOR TO ASSEMBLY TO INCREASE THEIR COMPRESSIVE STRENGTH. STRETCH BOLTS ARE UTILIZED TO ASSURE THE REQUIRED CLAMPING LOAD IS ACHIEVED. THE CUPWASHERS ARE STAKED AT ASSEMBLY TO PREVENT BOLT ROTATION. ASSEMBLY PROCEDURES FOR LOCKING DEVICES ENSURE DEFECT-FREE INSTALLATION (8). THE BOLTS, CUPWASHERS, AND STATIC SEAL ARE NOT SERIALIZED OR TIME HISTORY TRACKED, BUT HAVE INFINITE ALLOWABLE LIFE (9).

(1) R0019230; (2) RSS-8560-10; (3) RS007553; (4) RS007577, RS007568; (5) RE1621; (6) RS007595. (7) RS007523; (8) RL00351; (9) RL00532, CP320R0003B

FAILURE CAUSE: D: Fracture of second-stage aft platform seal.

THE SECOND-STAGE AFT PLATFORM SEAL (1) IS MANUFACTURED UTILIZING A RENE-41 FORGING (2), WHICH WAS SELECTED FOR ITS TEMPERATURE AND STRENGTH PROPERTIES, AND CORROSION RESISTANCE (2). THE MATERIAL IS SOLUTION TREATED AND AGE-HARDENED. THE SEAL IS COPPER-PLATED TO PROTECT THE BASE MATERIAL FROM HYDROGEN ENVIRONMENT EMBRITTLEMENT (2). THE SEAL CONTROLS THE ENVIRONMENT ON THE DOWNSTREAM SIDE OF THE SECOND-STAGE DISK. IT IS PILOTED AT ASSEMBLY ON THE OUTSIDE DIAMETER OF THE HUB LABYRINTH SEAL (3). PILOTING IN OPERATION IS PROVIDED BY 6 RADIAL TANGS WHICH ENGAGE SLOTS IN A RETAINER (6). A THIN CIRCULAR LIP ON THE PLATFORM SEAL ENGAGES A SLIGHTLY WIDER GROOVE IN THE RETAINER. THIS POSITIONS THE SEAL AXIALLY, WHILE PERMITTING THE SEAL TO EXPAND AND CONTRACT FREELY UNDER ITS OWN THERMAL ENVIRONMENT TO REDUCE ITS OPERATING STRESSES. THE RETAINER IS SECURED TO THE LIFT-OFF SEAL STACK BY 12 A-286 CRES BOLTS (5) AND 321 CRES CUPWASHERS (6). STRETCH BOLTS ARE UTILIZED TO ASSURE THE REQUIRED PRELOAD ON THE STACK IS ACHIEVED. THE CLEARANCE BETWEEN THE BLADES AND THE SEALS IS CONTROLLED TO MINIMIZE RUBBING WHILE REDUCING BYPASS LEAKAGE

(1) RS007593 (2) RSS-8560-10. (3) RS007553; (4) RS007596; (5) RS007595; (6) RS007523

Design / Document Reference

FAILURE CAUSE: E: Pump back plate through crack.

THE MAIN BODY OF THE TURBOPUMP HOUSING (1) IS A WELDMENT OF AN INCONEL 718 FORGING AND AN INCONEL 718 CASTING (BACKPLATE) (2). INCONEL 718 WAS SELECTED FOR ITS HIGH STRENGTH, CRYOGENIC DUCTILITY, RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING, AND IS INSENSITIVE TO HYDROGEN ENVIRONMENT EMBRITTLEMENT AT OPERATING TEMPERATURES (2). THE MATERIAL IS SOLUTION TREATED AND AGE-HARDENED. THE PARTS ARE JOINED BY AN ELECTRON BEAM WELD. ELECTRON BEAM WELDING PRODUCES A CLEAN WELD WITH A SMALL HEAT EFFECTED ZONE AND MINIMAL DISTORTION. THE BALANCE CAVITY PRESSURE PASSAGE AND LIFT-OFF SEAL DRAIN LINE PASSAGE ARE MACHINED THROUGH THE BACKPLATE, BY THE JOINING OF TWO DRILLED HOLES. THE LOCATION OF THE HOLES ARE CLOSELY TOLERANCED TO MAXIMIZE THE AMOUNT OF SURROUNDING MATERIAL. THE MAIN HOUSING HAS BEEN DESIGN VERIFICATION TESTED FOR LOW CYCLE FATIGUE LIFE AND DEFLECTION (3). THE FACTOR OF SAFETY ON BURST HAS BEEN DEMONSTRATED BY DESIGN VERIFICATION TESTS (3).

(1) RS007577, RS007568; (2) RSS-8580 10. (3) RSS-404-25

FAILURE CAUSE: ALL CAUSES

THE HIGH AND LOW CYCLE FATIGUE LIFE FOR MAIN HOUSING TO LIFT-OFF STATIC SEAL, LIFT-OFF SEAL, TURBINE HUB LABYRINTH SEAL LIFT-OFF SEAL TO TURBINE HUB LABRYRINTH SEAL STATIC SEAL, LIFT-OFF SEAL STACK BOLTS AND CUPWASHERS, MAIN HOUSING BACKPLATE AND THE SECOND-STAGE AFT PLATFORM SEAL MEET CEI REQUIREMENTS (1). THE MINIMUM FACTORS OF SAFETY FOR THESE PARTS MEET CEI REQUIREMENTS (2). THE LIFT-OFF STATIC SEAL AND HOUSING, AND THE SECOND STAGE AFT PLATFORM SEAL PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH SINCE THEY ARE NOT FRACTURE CRITICAL PARTS, EXCEPT FOR THE HPFTP HOUSING WHICH WAS CLEARED BY CRITICAL INITIAL FLAW SIZE DETECTABILITY (3). THE FMEA/CIL WELDS ARE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH BY THE WELD ASSESSMENT (4). TABLE B200 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 INSPECTION. THOSE WELDS IN WHICH THE CRITICAL INITIAL FLAW SIZE IS NOT DETECTABLE ARE ACCEPTABLE FOR FLIGHT BY RISK ASSESSMENT (4). THE CONTROLLER SOFTWARE IS CONFIGURED TO DETECT AND RESPOND PROPERLY TO THE FAILURES IDENTIFIED AND COMMAND A SAFE ENGINE STATE (5). REUSE OF PARTS DURING OVERHAUL IS CONTROLLED BY THE REQUIREMENTS OF THE OVERHAUL SPECIFICATION (6).

(1) RL00532, CP320R0003B, (2) RSS-8546-16, CP320R0003B; (3) NASA TASK 117. (4) RSS-8756; (5) CP405R0002 PT 1 3.2.3:5.3; (6) RL00525

SSME FMEA/CIL
INSPECTION AND TEST

Component Group: Fuel Turbopumps
CIL Item: B300-20
Component: High Pressure Fuel Turbopump
Part Number: RS007501
Failure Mode: Excessive coolant flow.

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 4/21/99
Change #: 1
Directive #: CCBD ME3-01-5205

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A, B, C, D	STATIC SEAL HOUSING		RD261-3015 RS007568
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS	
		THE SEAL IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
	HEAT TREAT	SEAL HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020
	SURFACE FINISH	SEAL SILVER AND GOLD PLATING ARE VERIFIED PER SPECIFICATION REQUIREMENTS.	RA1509-001
	ASSEMBLY INTEGRITY	THE SEAL, LIFT-OFF SEAL, AND LABYRINTH SEAL SEALING SURFACES ARE INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS	RS007568 RD019230 RD261-3015 RL00531
	HPFTP		RS007501

Component Group: Fuel Turbopumps
CIL Item: B200-20
Component: High Pressure Fuel Turbopump
Part Number: RS007501
Failure Mode: Excessive coolant flow.

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 4/21/99
Change #: 1
Directive #: CCBD ME3-01-5206

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A, B, C, D	HPFTP		RS007501
	ASSEMBLY INTEGRITY	SEAL LEAK CHECK IS PERFORMED AT TURBOPUMP ASSEMBLY.	RL00351
		SEAL LEAK CHECK IS PERFORMED PRIOR TO EACH FLIGHT.	OMRSD V41BQ0.010
	SEAL ASSEMBLY HOUSING LABYRINTH SEAL SEAL, STATIC		R0019230 RS007553 RE1621
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS.	R0019230 RB0170-153 RB0170-154
		THE LABYRINTH SEAL IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
	HEAT TREAT	LABYRINTH SEAL AND STATIC SEAL HEAT TREATS ARE VERIFIED PER SPECIFICATION REQUIREMENTS	RA0611-020
	SURFACE FINISH	SEAL GOLD PLATING IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0109-007

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A, B, C, D	SURFACE FINISH	SEAL GOLD PLATING IS VERIFIED PER SPECIFICATION REQUIREMENTS	RA0109-007
	ASSEMBLY INTEGRITY	THE STATIC SEAL, LIFT-OFF SEAL, AND LABYRINTH SEAL SEALING SURFACES ARE INSPECTED PER DRAWING REQUIREMENTS.	R0019230 RS007553 RE1521
		THE LIFT-OFF SEAL AND LABYRINTH SEAL FLANGES SURFACE FINISH AND FLATNESS IS VERIFIED PER DRAWING REQUIREMENTS.	R0019230 RS007553
	BOLT CUPWASHER HOUSING		RS007595 RS007523 RS007568
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	
		BOLT AND CUPWASHER ARE PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS	RA0115-116
	HEAT TREAT	BOLT HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0160-014
	SURFACE FINISH	BOLT DRY-FILM LUBRICATION IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0112-003

Component Group: Fuel Turbopumps
CIL Item: B200-20
Component: High Pressure Fuel Turbopump
Part Number: RS007501
Failure Mode: Excessive coolant flow.

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 4/21/99
Change #: 1
Directive #: CCBD ME3-01-5206

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A, B, C, D	SURFACE FINISH	BOLT DRY-FILM LUBRICATION IS VERIFIED PER SPECIFICATION REQUIREMENTS	RA0112-003
	ASSEMBLY INTEGRITY	THE CUPWASHER IS LOAD TESTED PER DRAWING REQUIREMENTS	RS007523
		THE CUPWASHER DEFORMATION IS VERIFIED PER DRAWING REQUIREMENTS.	RS007501
		THE BOLT STRETCH IS VERIFIED PER ASSEMBLY DRAWING REQUIREMENTS.	
		LIFT-OFF SEAL STACK IS VERIFIED AS BOTTOMED PER SPECIFICATION REQUIREMENTS	RL00351
	SECOND-STAGE PLATFORM SEAL (TURBINE-END) RETAINER		RS007593 RS007596
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0170-049 RB0170-154
		SEAL FORGING IS PENETRANT AND ULTRASONIC INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116 RA0115-012

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A, B, C, D	MATERIAL INTEGRITY	SEAL FORGING IS PENETRANT AND ULTRASONIC INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116 RA0115-012
		THE SEAL IS PENETRANT INSPECTED PRIOR TO COPPER PLATING.	RA0115-116
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0511-020
	SURFACE FINISH	SEAL COPPER PLATING IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA1109-002
	ASSEMBLY INTEGRITY	SEAL AND PLATFORM SEALING SURFACE DIMENSIONS ARE VERIFIED PER DRAWING REQUIREMENTS.	RS007501 RS007593
	HPFTP		RS007501
	ASSEMBLY INTEGRITY	TORQUE CHECKS ARE PERFORMED PRIOR TO EACH FLIGHT.	OMRSD V41BS0 020
E	HOUSING, HPFTP RING		RS007566 RS007576
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0170-153 RB0170-155

Component Group:	Fuel Turbopumps	Prepared:	D. Early
CIL Item:	B200-20	Approved:	T. Nguyen
Component:	High Pressure Fuel Turbopump	Approval Date:	4/21/99
Part Number:	RS007501	Change #:	1
Failure Mode:	Excessive coolant flow.	Directive #:	CCBD ME3-01-5208
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
E	MATERIAL INTEGRITY	THE HOUSING AND RING FORGINGS ARE PENETRANT AND ULTRASONIC INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116 RA0115-012
		THE HOUSING IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
		THE HOUSING IS PROOF PRESSURE TESTED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007527 RL00143
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS	RA0611-020 RB0170-155
	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 RA0607-094 RA0115-116 RA0115-006 RA1115-001 RA0115-127
	ASSEMBLY INTEGRITY	DRAIN LINE AND BALANCE CAVITY PRESSURE PASSAGE POSITION IS INSPECTED PER DRAWING REQUIREMENTS	RS007568
ALL CAUSES	HPFTP		RS007501
	CLEANLINESS OF COMPONENTS	COMPONENTS ARE VERIFIED CLEANED PER SPECIFICATION REQUIREMENTS.	RL10001
	ASSEMBLY INTEGRITY	OPERATION/PERFORMANCE IS VERIFIED BY ENGINE HOT-FIRE TESTING AND 2ND E & M TESTS ON INSPECTIONS	RL00050-04 RL00056-06 RL00056-07 RL00461
		THE PUMP SUBASSEMBLIES ARE INSPECTED DURING OVERHAUL PER SPECIFICATION REQUIREMENTS. INSPECTIONS INCLUDE: VISUAL, DIMENSIONAL, PENETRANT, AND REPLACEMENT OF USAGE ITEMS AS APPLICABLE, PER OVERHAUL CLASSIFICATION.	RL00526 RA0115-116
		DATA FROM PREVIOUS FLIGHT OR HOT-FIRE IS REVIEWED FOR PROPER TURBOPUMP OPERATION/PERFORMANCE. (LAST TEST)	MSFC PLN 1228

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
Reference: NASA letter SA21/88/309 and Rocketdyne letter 88RC09761

Operational Use: Not Applicable.

SSME FMEA/CIL
FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE

Component Group: Fuel Turbopumps
Item Name: High Pressure Fuel Turbopump
Item Number: B200
Part Number: RS007501

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 4/21/99
Change #: 2
Directive #: CCBD ME3-01-5208

Base Line Rationale	Variance	Change Rationale	Variant Dash Number
1. B200-15 RS007502; CAUSE A. B200-24; RS007605; CAUSE A THE INNER AND OUTER BEARING RACES ARE EDDY CURRENT INSPECTED PER RL00743.	BEARING RACES RECEIVED FROM SUPPLIER SPLIT BALL BEARING INCORPORATED RECEIVED NO GENERAL EDDY CURRENT INSPECTION	GENERAL EDDY CURRENT INSPECTION OF RACES REPLACES TYPE IVC IN PENETRANT INSPECTION IN DETECTING SURFACE FLAWS USE AS IS RATIONALE: 1. RACES SUPPLIED BY SPLIT BALL BEARING INCORPORATED RECEIVED 10X VISUAL AND TYPE IVC PENETRANT INSPECTION INSTEAD OF GENERAL EDDY CURRENT INSPECTION. FLAW DETECTABILITY RELIABILITY LEVELS BETWEEN PENETRANT AND GENERAL EDDY CURRENT INSPECTIONS ARE 0.060 AND 0.057 RESPECTIVELY.	SEE DAR 2745 FOR VARIANT PART SERIAL NUMBERS.
2. B200-13 RS007527, RS007532, CAUSE A & B. B200-26: RS007532: CAUSE B. DIFFUSER HIDDEN SURFACES ARE PENETRANT INSPECTED PER RL00343.	SOME DIFFUSERS MAY NOT RECEIVE THE POST PROOF TEST HIDDEN SURFACE IIa PENETRANT INSPECTION	USE AS IS RATIONALE 1 IMPLEMENTATION OF HIDDEN SURFACE INSPECTION REQUIREMENT IS NOT A RESULT OF AN OBSERVED HARDWARE ANAOMALY BUT AS A RESULT OF ROCKETDYNE'S STAND DOWN.	SEE DAR 2751 FOR VARIANT PART SERIAL NUMBERS
3 B200-14 CAUSE A, RS007568 B200-21 CAUSE B, RS007568 B200-26 CAUSE A, RS007568 WELD JOINTS RS007568 TABLE B200 HPFTP FMEA/CIL WELD JOINTS RS007568 HOUSING CURRENT CONFIGURATION IS THE ONE(1) PIECE "-113" CAP, USING FOUR (4) WELDS AND FOUR (4) WELD NUMBERS	SOME HOUSINGS (POSSIBLY TWO) MAY HAVE BEEN FABRICATED WITH THE TWO (2) PIECE "-113" CAPS (THIS HAS AN EXTRA WELD: #13 AND THREE EXTRA WELD NUMBERS 13, 68 & 69)	TO REDUCE CONFUSION ON THE DRAWING AND ON THE MANUFACTURING FLOOR	SEE MCR 2524. SAME -113 DASH NUMBER.
4 B200-02; CAUSE A, RS007524 CAUSE B, RS007524; CAUSE C, RS007524	SOME TURBINE BEARING SUPPORTS (RS007524) ARE FABRICATED USING A WELDMENT OF HAYFS 188 SHEET METAL INSTEAD OF THE EDM FORGING.	HIGH CYCLE FATIGUE INDUCED INLET SHEET METAL CRACKS DO OCCUR FROM THE OPERATIONAL ENVIRONMENT EXPERIENCED DURING ENGINE OPERATION. THE CRACKING IS CONTROLLED PER THE REQUIREMENTS OF THE SHEET METAL INSPECTION SPECIFICATION (RL00655) WHICH LIMITS THE CRACKING LENGTH, SPACING, AND SHAPE, TO PRECLUDE SHEET METAL PIECES FROM DISLODGING. THE CRITERIA IS BASED ON CRACK GROWTH RATES AND ENGINE TEST EXPERIENCE. ANY CRACKS, WHICH EXCEED THE SPECIFICATION LIMITS, ARE WELD REPAIRED (RF0001-007). THE TURBINE BEARING SUPPORT WITH WELDED SHEET METAL IS LIFE LIMITED BY MAJOR WAIVER DAR 2709.	RS007524-201 AND SUBS.

Component Group: Fuel Turbopumps
Item Name: High Pressure Fuel Turbopump
Item Number: B200
Part Number: RS007501

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 4/21/99
Change #: 2
Directive #: CCBD ME3-01-5206

Base Line Rationale	Variance	Change Rationale	Variant Dash Number
5 B200-16 CAUSE A, B200-17 CAUSE A, B200-18 CAUSE A, B200-19 CAUSE A, B200-22; CAUSE A,B,C,E	SOME LIFT-OFF SEAL HOUSING DRAIN LINES ARE FABRICATED USING INTERSECTING LINE DRILLED HOLES THE HOLE THAT INTERSECTS THE OUTSIDE DIAMETER OF THE HOUSING FLANGE HAS A PLUG INSTALLED. THE PLUG IS THEN WELDED AT THE HOUSING OUTSIDE DIAMETER TO FORM A TIGHT GAS SEAL	LOW CYCLE FATIGUE CRACKING HAS BEEN OBSERVED IN THE PLUG WELD. CRACK INITIATION AND PROPAGATION OCCURS AT SHUTDOWN/COOLDOWN ALL UNITS RECEIVE A STANDARD POST FLIGHT INSPECTIONS BY LEAK CHECK. LEAK CHECK POST FLIGHT WILL DETECT A CRACK PRIOR TO REFLIGHT. POST LEAKAGE AT THE DRAIN LINE IS LIMITED TO 10 SCIM. ALL FLIGHT UNITS WILL CONTINUE TO RECEIVE A LEAK CHECK POST FLIGHT FOR THE DRAIN LINE PLUG WELD UNITL THE ENTIRE FLEET IS RETROFIT WITH THE EDM DRAIN LINE CONFIGURATION	R0019230-071 AND SUBS.

SSME FMEA/CIL
WELD JOINTS

Component Group: Fuel Turbopumps
CIL Item: B200
Component: High Pressure Fuel Turbopump
Part Number: RS007501

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 4/21/99
Change #: 2
Directive #: CCBD ME3-01-5206

Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial Flaw Size Not Detectable HCF	LCF	Comments
SHIELD	R0012171	1-24, 28-62	GTAW	II	X			
SHIELD	R0012171	26	GTAW	II				
LIFT-OFF SEAL	R0019230	1, 2	GTAW	II	X			
SHIELD	R0019788	26, 28	GTAW	II				
SHIELD	R0019788	27 50	GTAW	II	X			
SHIELD	R0019788	51, 52	GTAW	I				
SHIELD	R0019788	53, 55	GTAW	II				
BELLOWS	RS007505	1-4	GTAW	I		X		
BELLOWS	RS007505	5, 6	EBW	I		X		
INLET	RS007512	4	GTAW	I		X		
INLET	RS007512	5-6	GTAW	I				
INLET	RS007512	7-10, 12, 13	GTAW	I				
INLET	RS007512	11	EBW	II				
INLET	RS007512	14 15	GTAW	I				
INLET	RS007512	16	GTAW	I		X		
BEARING SUPPORT	RS007524	14	EBW	I				
BEARING SUPPORT	RS007524	18	EBW	I	X			
BEARING SUPPORT	RS007524	29, 30	GTAW	I	X	X		
BEARING SUPPORT	RS007524	1*8	GTAW	I	X			
BEARING SUPPORT	RS007524	119, 121	EBW	I				
BEARING SUPPORT	RS007524	120	GTAW	II	X			
BEARING SUPPORT	RS007524	229-241	GTAW	II	X			
HOUSING	RS007568	75 223, 228 230 298	GTAW	I	X	X	X	
HOUSING	RS007568	74	GTAW	I				
HOUSING	RS007568	48	EBW	I	X	X	X	
HOUSING	RS007568	49	GTAW	I	X			
HOUSING	RS007568	51	GTAW	II	X	X		
HOUSING	RS007568	52	GTAW	II	X			
HOUSING	RS007568	53	EBW	I				

Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial Flaw Size Not Detectable HCF	LCF	Comments
HOUSING	RS007568	55	EBW	II	X			
HOUSING	RS007568	56	GTAW	II	X			
HOUSING	RS007568	57, 324 325	GTAW	II				
HOUSING	RS007568	58	GTAW	II	X	X	X	
HOUSING	RS007568	59	EBW	I				
HOUSING	RS007568	74, 229, 297	GTAW	I	X	X	X	
HOUSING	RS007568	76, 77	GTAW	I		X		
HOUSING	RS007568	78-89	GTAW	II	X			
HOUSING	RS007568	90-101	GTAW	II	X			
HOUSING	RS007568	102	GTAW	I	X			
HOUSING	RS007568	139	GTAW	II	X			
HOUSING	RS007568	140	GTAW	II	X			
HOUSING	RS007568	153, 154	GTAW	II	X			
HOUSING	RS007568	174-185	GTAW	II	X			
HOUSING	RS007568	191 192, 195, 196 245, 455 456	GTAW	II	X	X		
HOUSING	RS007568	193, 194, 197-202 204-207	GTAW	II		X		
HOUSING	RS007568	203, 217, 218, 234, 236	GTAW	II	X	X		
HOUSING	RS007568	212, 213	GTAW	II				
HOUSING	RS007568	214 215	GTAW	II	X			
HOUSING	RS007568	222, 239	GTAW	I		X		
HOUSING	RS007568	224, 225	GTAW	I		X	X	
HOUSING	RS007568	226, 227	GTAW	I		X		
HOUSING	RS007568	231, 232	GTAW	II	X	X		
HOUSING	RS007568	233	GTAW	II	X			
HOUSING	RS007568	237 238	GTAW	II				
HOUSING	RS007568	246-248	GTAW	II				
HOUSING	RS007568	326-349	GTAW	II	X			
HOUSING	RS007568	374-397	GTAW	II	X			
HOUSING	RS007568	399	GTAW	I	X	X	X	

Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial Flaw Size Not Detectable HCF	Critical Initial Flaw Size Not Detectable LCF	Comments
HOUSING	RS007568	401-424	GTAW	II	X			
HOUSING	RS007568	425-448	GTAW	II	X			
HOUSING	RS007568	450 (OPT)	GTAW	II				
HOUSING	RS007568	450 (OPT)	EBW	II	X			
HOUSING	RS007568	454	GTAW	II	X			
HOUSING	RS007568	537 (OPT)	GTAW	II				
ROTOR SEAL	RS007588	1	EBW	I				
SEAL	RS007592	25	EBW	II	X			