# SSME FMEA/CIL
# REDUNDANCY SCREEN

| | |
|---|---|
| Component Group: | Combustion Devices |
| CIL Item: | A205-08 |
| Part Number: | RS009122 |
| Component: | Baffleless Main Injector (Phase II+) |
| FMEA Item: | A205 |
| Failure Mode: | LOX post crack. |

| | |
|---|---|
| Prepared: | A. Kay |
| Approved: | T. Nguyen |
| Approval Date: | 9/9/99 |
| Change #: | 1 |
| Directive #: | CCBD MES-01-5238 |
| Page: | 1 of 1 |

| Phase | Failure / Effect Description | Criticality Hazard Reference |
|---|---|---|
| SMC 4.1 | Oxidizer flows out of the post, ignites with the hot gases and begins post injector burnout. Injector debris ruptures nozzle tubes, causing preburner fuel starvation, turbine and main injector burnout, and aft compartment overpressurization and fire. Loss of vehicle<br><br>Redundancy Screens: SINGLE POINT FAILURE: N/A | 1<br>ME-FB4S,<br>ME-FB4M,<br>ME-FB4A,C |

# SSME FMEA/CIL
# DESIGN

| | | | |
|---|---|---|---|
| Component Group: | Combustion Devices | Prepared: | A. Kay |
| CIL Item: | A205-06 | Approved: | T. Nguyen |
| Part Number: | RS009122 | Approval Date: | 9/9/99 |
| Component: | Baffleless Main Injector (Phase II+) | Change #: | 1 |
| FMEA Item: | A205 | Directive #: | CCBD ME3-01-5238 |
| Failure Mode: | LOX post crack. | Page: | 1 of 2 |

Design / Document Reference

**FAILURE CAUSE: A: Impact damage.**

HAYNES 188 ALLOY WAS SELECTED FOR THE MAIN INJECTOR LOX POSTS (1) ON THE BASIS OF ITS CREEP STRENGTH AT ELEVATED TEMPERATURES, LOW CYCLE FATIGUE LIFE IN A HIGH PRESSURE HYDROGEN ENVIRONMENT (2) AND ITS WELD COMPATABILITY WITH INCONEL 718 ALLOY. THE FLOW SHIELDS, HEAT SHIELD RETAINERS AND SECONDARY FACEPLATE RETAINERS PROTECT THE OUTER ROWS OF LOX POSTS FROM HIGH TURBULENCE FLOW AT THE HOT-GAS MANIFOLD DUCT OPENINGS AND FROM FOREIGN OBJECT IMPACT (3). THE MINIMUM FACTORS OF SAFETY FOR THE MAIN INJECTOR LOX POSTS MEET CEI REQUIREMENTS (4).

(1) RS009207; (2) RSS-8572-10; (3) RS009122; (4) RSS-8560 CP320R0003B

**FAILURE CAUSE: B: Weld or material flaws.**

PARENT MATERIAL IS HAYNES 188 PROCURED TO DRAWING SPECIFICATIONS (1). HAYNES HAS GOOD STRENGTH, DURABILITY, AND WELDABILITY (2). THE WELDS ARE A FRICTION INERTIA PROCESS. THE WELDS ARE CONTROLLED BY TEST SAMPLING AND PROCESS CONTROLS (3). CONTROLS INCLUDE AXIAL UPSET, THRUST, LOAD vs TIME, TORQUE vs TIME, AND SPINDLE SPEEDS. HIGH CYCLE AND LOW CYCLE FATIGUE LIFE REQUIREMENTS OF THE MAIN INJECTOR LOX POSTS MEET CEI REQUIREMENTS (4). THE MINIMUM FACTORS OF SAFETY FOR THE MAIN INJECTOR LOX POSTS MEET CEI REQUIREMENTS (5). THE MAIN INJECTOR LOX POST PARENT MATERIAL WAS CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH SINCE THEY CONTAIN NO FRACTURE CRITICAL PARTS (6). THE FMEA/CIL WELDS ARE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH BY THE WELD ASSESSMENT (7). TABLE A205 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 (7).

(1) RS009207; (2) RSS-8572-10; (3) RA1507-044; (4) RL00532, CP320R0003B; (5) RSS-8548, CP320R0003B; (6) NASA TASK 117; (7) RSS-8756

**FAILURE CAUSE: C: Fatigue.**

THE HEAT SHIELD RETAINERS PROTECT THE BASE OF THE POSTS AND INERTIA WELD JOINT FROM THE HOT GAS STREAM. THE POST IS SUPPORTED BY THE SECONDARY FACEPLATE RETAINER AND FUEL SLEEVE (1). THE LOWER AREA OF THE POST IN THE HOT GAS STREAM HAS SPIRAL RIBBING ALONG THE POST LENGTH WHICH DESENSITIZES THE POST TO VORTEX SHEDDING PHENOMENA AND PROVIDES ADDITIONAL STRUCTURAL STRENGTH (2). ALL FLIGHT ENGINES HAVE HAYNES 188 POSTS FOR STRENGTH AND DURABILITY. HYDROGEN TRANSPIRATION COOLING OF THE INJECTOR FACEPLATE RESTRICTS THERMAL GROWTH WHICH GREATLY REDUCES THE POSSIBILITY OF CRACKING AN INJECTOR ELEMENT. THE BENDING FLEXIBILITY OF THE LIQUID OXYGEN POSTS IS SUFFICIENT TO COMPLY WITH THE RADIAL THERMAL EXPANSION AND CONTRACTION OF THE INJECTOR FACE. A FATIGUE ANALYSIS FOR THE BAFFLELESS MAIN INJECTOR RESULTED IN ACCEPTANCE MARGINS OF HIGH CYCLE FATIGUE AND LOW CYCLE FATIGUE WHICH MEETS CEI REQUIREMENTS (3). LOW STRAINS ARE MAINTAINED BELOW CRACK INITIATION LEVELS FOR HYDROGEN ENVIRONMENT (4).

(1) RS009122; (2) RS009207; (3) RL00532, CP320R0003B; (4) RSS-8572-10

**FAILURE CAUSE: D: Heat shield retainer failure.**

THE HEAT SHIELD RETAINER ACTS AS AN INSULATOR FOR THE INCONEL 718 BODY, PROTECTING IT FROM THE THERMAL STRAINS THAT WOULD BE CREATED IF HOT-GAS WERE ALLOWED TO DIRECTLY CONTACT THE INCONEL 718 ALLOY (1). THE HEAT SHIELD RETAINERS (2) ARE FABRICATED FROM 316 STAINLESS-STEEL. THE 316 STAINLESS-STEEL IS RESISTANT TO HYDROGEN ENVIRONMENT EMBRITTLEMENT. ALL MATERIAL IS PROCURED PER DRAWING REQUIREMENTS (3). THE HEAT SHIELD RETAINER IS A THIN WALLED SHELL THAT FITS OVER THE BASE OF EACH MAIN INJECTOR LOX POST (4) TO PROTECT THE INERTIA WELD AND THE BASE OF THE POST FROM DIRECT CONTACT WITH THE HOT-GAS. MAIN INJECTOR LOX POST BASES WERE REDESIGNED TO INCLUDE AN ELLIPTICAL RADIUS TO INCREASE THE FATIGUE LIFE. THE HEAT SHIELD RETAINER ACHIEVES ITS INSULATING EFFECT AS A RESULT OF ITS DESIGN WHICH FEATURES AN AIR CAVITY BETWEEN THE POST AND RETAINER. THE HEAT SHIELD RETAINER IS HELD IN PLACE BY A CRIMP RING AND MAINTAINS THE HEAT SHIELD IN POSITION AGAINST THE SURFACE OF THE INTERPROPELLANT PLATE. THE HIGH CYCLE AND LOW CYCLE FATIGUE LIFE AND MINIMUM FACTORS OF SAFETY MEET CEI REQUIREMENTS (5). THE HEAT SHIELD RETAINER WAS CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH BY EITHER DETECTION OF THE CRITICAL INITIAL FLAW SIZE OR RISK ASSESSMENT (6). CONTINUED USE WITH ALLOWABLE DISCREPANCIES RESULTING FROM OPERATION IS EVALUATED AND CONTROLLED PER THE REQUIREMENTS OF THE MAINTENANCE CONTROL DOCUMENT (7).

(1) RSS-8572-10; (2) RS009144; (3) RS009144; (4) RS009207; (5) RL00532, CP320R0003B, RSS-8560; (6) NASA TASK 117; (7) RSS-8559-1-7

| | | | |
|---|---|---|---|
| Component ID: | Combustion Devices | Prepared: | A. Kay |
| CIL Item: | A205-06 | Approved: | T. Nguyen |
| Part Number: | RS009122 | Approval Date: | 9/9/99 |
| Component: | Baffleless Main Injector (Phase II+) | Change #: | 1 |
| FMEA Item: | A205 | Directive #: | CCBD ME3-01-5238 |
| Failure Mode: | LOX post crack. | Page: | 2 of 2 |

Design / Document Reference

FAILURE CAUSE: E: Secondary faceplate retainer failure.

THE SECONDARY FACEPLATE RETAINERS (1) ARE FABRICATED FROM HAYNES 188 ALLOY. THIS MATERIAL WAS SELECTED FOR ITS CREEP STRENGTH AT ELEVATED TEMPERATURES AND ITS LOW-CYCLE FATIGUE LIFE IN HIGH PRESSURE HYDROGEN ENVIRONMENT (2). THE ALLOY IS PROCURED PER DRAWING REQUIREMENTS (3). THE SECONDARY FACEPLATE RETAINER IS DESIGNED TO PROVIDE A SUPPORT POINT FOR THE LOX POST, LOCATE AND HOLD THE SECONDARY FACEPLATE IN PLACE AND CHANNEL FUEL RICH GASES DOWN ALONG THE OUTSIDE OF THE LOX POST (4). HIGH CYCLE AND LOW CYCLE FATIGUE LIFE AND MINIMUM FACTORS OF SAFETY FOR THE SECONDARY FACEPLATE RETAINER MEET CEI REQUIREMENTS (5). THE SECONDARY FACEPLATE RETAINER PARENT MATERIAL WAS CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH SINCE IT CONTAINS NO FRACTURE CRITICAL PARTS (6). CONTINUED USE WITH ALLOWABLE DISCREPANCIES RESULTING FROM OPERATION IS EVALUATED AND CONTROLLED PER THE REQUIREMENTS OF THE MAINTENANCE CONTROL DOCUMENT (7).

(1) RS009133; (2) RSS-8572-10; (3) RS009133; (4) RS009207; (5) RL00532, CP320R0003B, RSS-8550; (6) NASA TASK 117; (7) RSS-8559-1-1-7

FAILURE CAUSE: F: Loss of function of flow shield.

THE MAIN INJECTOR FLOW SHIELDS ARE FABRICATED FROM INCOLOY 903 (1). INCOLOY 903 ALLOY WAS SELECTED ON THE BASIS OF ITS THERMAL EXPANSION CHARACTERISTICS (2) WHICH INHIBIT THERMAL CRACKING. THE PHASE II+ CONFIGURATION FLOW SHIELDS FEATURES AN INCREASE IN OPEN AREA TO REDUCE HOT GAS PRESSURE AND PREVENT HOT-GAS INGESTION IN THE COOLANT CIRCUIT. THE MAIN INJECTOR FLOW SHIELDS ARE DESIGNED TO DISTRIBUTE THE FLOW LOADS ON THE ROW 1 POSTS AND REDUCE THE LOAD CONCENTRATIONS (3). THE PHASE II+ CONFIGURATION FLOW SHIELD POSITION HAS BEEN MODIFIED TO ALLOW A MORE SYMMETRICAL HOT-GAS FLOW AROUND THE INJECTOR. THE SHIELDS ALSO PROTECT THE POSTS FROM ANY CONTAMINATION IN THE FLOW. THE HIGH CYCLE AND LOW CYCLE FATIGUE LIFE AS WELL AS MINIMUM FACTORS OF SAFETY MEET CEI REQUIREMENTS (4). THE MAIN INJECTOR FLOW SHIELDS PARENT MATERIAL WAS CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH SINCE THEY CONTAIN NO FRACTURE CRITICAL PARTS (5). DURING DISASSEMBLY OF THE MAIN INJECTOR FROM ENGINE 0209, NO ANOMALIES WITH THE FLOW SHIELDS WERE NOTED. CONTINUED USE WITH ALLOWABLE DISCREPANCIES RESULTING FROM OPERATION IS EVALUATED AND CONTROLLED PER THE REQUIREMENTS OF THE MAINTENANCE CONTROL DOCUMENT (6).

(1) RS010530; (2) RSS-8572-10; (3) RS009122; (4) RL00532, CP320R0003B, RSS-8548; (5) NASA TASK 117; (6) RSS-8559-1-1-7

# SSME FMEA/CIL
# INSPECTION AND TEST

| | | | |
|---|---|---|---|
| Component Group: | Combustion Devices | Prepared: | A. Kay |
| CIL Item: | A205-06 | Approved: | T. Nguyen |
| Part Number: | RS009122 | Approval Date: | 9/9/99 |
| Component: | Baffleless Main Injector (Phase II+) | Change #: | 1 |
| FMEA Item: | A205 | Directive #: | CCBD ME3-01-5238 |
| Failure Mode: | LOX post crack. | Page: | 1 of 4 |

| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference |
|---|---|---|---|
| A | POSTS<br>FLOW SHIELD<br>SECONDARY FACEPLATE RETAINER<br>HEAT SHIELD RETAINER<br>BODY ASSY | | RS009207<br>R0019630<br>RS009133<br>RS009144<br>RS009237 |
| | UPSTREAM COMPONENT CLEANLINESS | ALL UPSTREAM COMPONENTS ARE CLEANED TO FUEL/LOX USAGE TO VERIFY ABSENCE OF CONTAMINATION/DAMAGING CAUSING DEBRIS | RL10001 |
| | POST PROTECTION SHIELDING INTEGRITY | ALL ACCESSIBLE FLOW SHIELDS, SECONDARY FACEPLATE RETAINERS, AND HEAT SHIELD RETAINERS ON OUTER ROWS ARE VISUALLY AND BORESCOPE INSPECTED FOR SECURITY AND DAMAGE PRIOR TO EACH FLIGHT AND WHENEVER HIGH PRESSURE PUMPS ARE REMOVED. RETAINERS ARE INSPECTED ON OUTER DIAMETER FACING PORTIONS ONLY (LAST TEST). | OMRSD V41BU0.040<br>OMRSD V41BU0.081<br>OMRSD V41BU0.082 |
| B, C | POSTS | | RS009207 |
| | LOX POST MATERIAL INTEGRITY | MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS. | AMS 5772 |
| | | THE POST MATERIAL IS ULTRASONICALLY INSPECTED PRIOR TO MACHINING. | RA0115-312 |
| | | THE POST MATERIAL IS HEAT TREATED TO SPECIFICATION REQUIREMENTS. | RA0111-018 |
| | POST SURFACE FINISH | BEFORE WELDING, POST OUTSIDE SURFACES ARE PENETRANT INSPECTED. POST I.D. IS BORESCOPED AT MINIMUM 4X POWER MAGNIFICATION FOR FLAWS. | RA0115-116<br>RS009207 |
| | | THE SURFACE FINISH IS INSPECTED PER DRAWING REQUIREMENTS. | RS009207 |
| | | AFTER WELDING, THE POST O.D. AND I.D. ARE BORESCOPE INSPECTED FOR DEFECTS PER DRAWING AND SPECIFICATION REQUIREMENTS. | RS009237<br>RI00350 |
| | WELD INTEGRITY - INERTIA WELD JOINT | ALL WELD PROCESS CONTROL SAMPLES ARE DESTRUCTIVELY TESTED PRIOR TO AND AFTER WELDING. THE WELD SCHEDULE PARAMETERS ARE VERIFIED BY MACHINE READOUTS AFTER EVERY WELD. IN-PROCESS WELD PARAMETER INSPECTIONS INCLUDE AXIAL UPSET MEASUREMENT, THRUST, LOAD vs TIME, TORQUE vs TIME, AND SPINDLE SPEED | RA1607-044 |

| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference |
|---|---|---|---|
| B, C | WELD INTEGRITY - INERTIA WELD JOINT | ALL ROW 13 POSTS ARE ETCHED AND PENETRANT INSPECTED, OD ONLY, AFTER MACHINING OF WELD FLASH. | RA0115-116 |
| | | ALL POSTS ARE EDDY CURRENT INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS. | RS009237<br>RL00638 |
| | SMOOTH TRANSITION ACROSS THE INERTIA WELD AREA I.D. AND O.D. | THE OUTER ROW OF POSTS ARE INSPECTED FOR MISMATCH IN THE INERTIA WELDED AREA | RS009237 |
| | | THE O.D. AND I.D. ARE INSPECTED FOR DEFECTS PER DRAWING AND SPECIFICATION REQUIREMENTS. | RS009237<br>RL00960 |
| | | AFTER WELDING AND MACHINING THE POSTS ARE INSPECTED TO VERIFY THE STUB I.D. DIAMETER IS CONTAINED WITHIN THE POST BORE DIAMETER. | RS009237 |
| | | INERTIA WELDS ARE LEAK TESTED WITH HELIUM FOR DEFECTS. INERTIA WELDS ARE PROOF PRESSURE TESTED | RS009237<br>RS009126 |
| | | THE EXTERNAL SURFACE OF INERTIA WELDS OF ROW 13 ARE VISUALLY INSPECTED AFTER PROOF PRESSURE. | RS009126 |
| | ASSEMBLY INTEGRITY | THE HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY INJECTOR POST INTEGRITY. | RL00050-04<br>RL00050-06<br>RL00050-07 |
| | | A VISUAL INSPECTION IS PERFORMED AFTER EACH FLIGHT FOR EVIDENCE OF THERMAL DAMAGE TO THE INJECTOR (LAST TEST) | OMRSD V41BU0.040 |
| D | HEAT SHIELD RETAINER | | RS009144 |
| | MATERIAL INTEGRITY | MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. | AMS-5573 |
| | | THE RETAINER IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS. | RA0115-116 |
| | ASSEMBLY INTEGRITY | THE RETAINER IS CLEANED AND INSPECTED PER SPECIFICATION REQUIREMENTS | RA0115-018<br>RL10001 |

| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference |
|---|---|---|---|
| D | ASSEMBLY INTEGRITY | THE RETAINER IS INSTALLED AND INSPECTED PER SPECIFICATION AND DRAWING REQUIREMENTS. | RA0112-002<br>RL00191<br>RS009122 |
| | | THE RETAINERS ARE INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS FOR FINAL ASSEMBLY ACCEPTANCE. | RL00191<br>RS009122 |
| | | HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY INJECTOR POST INTEGRITY. | RL00050-04<br>RL00056-06<br>RL00056-07 |
| | | A VISUAL INSPECTION IS PERFORMED AFTER EACH FLIGHT FOR EVIDENCE OF THERMAL DAMAGE TO THE INJECTOR | OMRSD V41BU0.040 |
| | | ALL ACCESSIBLE FLOW SHIELDS, SECONDARY FACEPLATE RETAINERS, AND HEAT SHIELDS ON OUTER ROWS ARE VISUALLY AND BORESCOPE INSPECTED FOR SECURITY AND DAMAGE PRIOR TO EACH FLIGHT AND AT HIGH PRESSURE PUMP ARE REMOVAL. RETAINERS ARE INSPECTED ON OUTER DIAMETER FACING PORTIONS ONLY (LAST TEST). | OMRSD V41BU0.040<br>OMRSD V41BU0.081<br>OMRSD V41BU0.082 |
| E | SECONDARY FACEPLATE RETAINER | | RS009133 |
| | MATERIAL INTEGRITY | MATERIAL INTEGRITY IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS. | RS009133<br>AMS 5772 |
| | | RETAINER IS PENETRANT INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS | RA0116-116 |
| | ASSEMBLY INTEGRITY | RETAINER IS CLEANED AND INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS. | RL10001 |
| | | RETAINERS ARE INSTALLED AND INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS. | RS009133<br>RA0112-003 |
| | | RETAINERS ARE INSPECTED PER DRAWING REQUIREMENTS FOR FINAL ASSEMBLY ACCEPTANCE. | RS009122<br>RS009133 |
| | | HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY INJECTOR POST INTEGRITY. | RL00050-04<br>RL00056-06<br>RL00056-07 |
| | | AFTER EACH FLIGHT A VISUAL INSPECTION IS PERFORMED TO CHECK FOR EVIDENCE OF THERMAL DAMAGE TO THE INJECTOR. | OMRSD V41BU0.040 |
| | | ALL ACCESSIBLE FLOW SHIELDS, SECONDARY FACEPLATE RETAINERS, AND HEAT SHIELD RETAINERS ON OUTER ROWS ARE VISUALLY AND BORESCOPE INSPECTED FOR SECURITY AND DAMAGE PRIOR TO EACH FLIGHT AND WHENEVER HIGH PRESSURE PUMPS ARE REMOVED. RETAINERS ARE INSPECTED ON OUTER DIAMETER FACING PORTIONS ONLY (LAST TEST). | OMRSD V41BU0.040<br>OMRSD V41BU0.081<br>OMRSD V41BU0.082<br>R0019530 |
| F | CLIP - POST STRAIGHTENING MAIN INJECTOR | | R0019530 |
| | NUT | | R0011573 |
| | T-BOLT, POST STRAIGHTENING MAIN INJECTOR | | R0019531 |

| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference |
|---|---|---|---|
| F | MATERIAL INTEGRITY | MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS. | RSO170-196 |
| | | PENETRANT INSPECTION IS PERFORMED PER SPECIFICATION REQUIREMENTS. | RA01[illegible]-116 |
| | ASSEMBLY INTEGRITY | CLEANING AND INSPECTION IS PERFORMED PER SPECIFICATION REQUIREMENTS. | RL10001 |
| | | FLASH SILVER PLATING ON NUT IS INSPECTED PER DRAWING REQUIREMENTS | RJ011573 |
| | | NUT TORQUE IS APPLIED AND INSPECTED PER DRAWING REQUIREMENTS. | RS009122 |
| | | INSTALLATION IS ACCOMPLISHED PER SPECIFICATION AND DRAWING REQUIREMENTS. | |
| | | CLIP HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS. | RA0811-020 |
| | | A VISUAL INSPECTION IS PERFORMED AFTER INSTALLATION HAS BEEN COMPLETED AND THREAD MELT | RS009122 |
| | | NUTS ARE ACCEPTANCE INSPECTED PRIOR TO FINAL ASSEMBLY PER DRAWING REQUIREMENTS. | RC011573<br>RS009122 |
| | | HOT FIRE TESTING AND 2ND E & M INSPECTIONS VERIFY POST INTEGRITY | RL00050-04<br>RL00056-06<br>RL00056-07 |
| | | A VISUAL INSPECTION IS PERFORMED AFTER EACH FLIGHT FOR EVIDENCE OF THERMAL DAMAGE TO THE INJECTOR | OMRSD V41BU0.040 |
| | | ALL ACCESSIBLE FLOW SHIELDS, SECONDARY FACEPLATE RETAINERS, AND HEAT SHIELD RETAINERS ON OUTER ROWS ARE VISUALLY AND BORESCOPE INSPECTED FOR SECURITY AND DAMAGE PRIOR TO EACH FLIGHT AND WHENEVER HIGH PRESSURE PUMPS ARE REMOVED. AT HIGH PRESSURE PUMPS REMOVAL, FLOW SHIELDS ARE PHYSICALLY INSPECTED FOR TIGHTNESS. RETAINERS ARE INSPECTED ON OUTER DIAMETER FACING PORTIONS ONLY (LAST TEST). | OMRSD V41BU0.040<br>OMRSD V41BU0.081<br>OMRSD V41BU0.082 |



Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
Reference: NASA Letter SA21/98-306 and Rocketdyne letter 98RC09761.

Operational Use: Not Applicable.

# SSME I A/CIL
# WELD JOINTS

Component Group: Combustion Devices
CIL Item: A205
Component: RS009122
Part Number: Baffleless Main Injector (Phase II+)
A205

Prepared: A. Kay
Approved: T. Nguyen
Approval Date: 9/9/99
Change #: 2
Directive #: CCBD ME3-01 5238


| Component | Basic Part Number | Weld Number | Weld Type | Class | Root Side Not Access | Critical Initial Flaw Size Not Detectable HCF | LCF | Comments |
|---|---|---|---|---|---|---|---|---|
| MAIN INJECTOR ASI LINE | RS009061 | 3 | GTAW | I | | X | X | |
| MAIN INJECTOR ASI LINE | RS009061 | 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 | | | | |
| 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 BODY | RS009126 | 14-15 | GTAW | I | X | X | X | |
| MAIN INJECTOR BODY | RS009126 | 16 | GTAW | I | X | X | X | |
| MAIN INJECTOR BODY | RS009126 | 17 | GTAW | I | X | X | X | |
| MAIN INJECTOR | RS009126 | 20 | GTAW | I | X | | | |
| MAIN INJECTOR | RS009126 | 21 | GTAW | I | X | | | |
| MAIN INJECTOR | RS009126 | 22 | GTAW | I | X | | | |
| MAIN INJECTOR | RS009126 | 23-29,54 | GTAW | I | X | | | |
| MAIN INJECTOR | RS009126 | 44-45 | EBW | I | X | X | X | |
| MAIN INJECTOR | RS009126 | 50-51 | EBW | Ia | X | X | X | |
| MAIN INJECTOR | RS009126 | 59 | EBW | I,Ib | X | | | |
| MAIN INJECTOR | RS009126 | 60-61 | GTAW | II | X | | | |
| MAIN INJECTOR BODY | RS009237 | 600 PLCS | FRW | I | | X | X | |
| MAIN INJECTOR LOX SUPPLY LINE | RS018015 | 1 | GTAW | I | X | X | | |

# FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE

Component Group: Combustion Devices
Item Name: Baffleless Main Injector (Phase II+)
Item Number: A205
Part Number: RS009122

Prepared: A. Kay
Approved: T. Nguyen
Approval Date: 9/9/99
Change #: 2
Directive #: CCBD ME3-01 5238



| Base Line Rationale | Variance | Change Rationale | Variant Dash Number |
|---|---|---|---|
| 1. NO RATIONALE EFFECTED | REWORKED BAFFLE POSTS EXIST ON 2 DASH NUMBERS. | INLINE REWORK OF COMPLETED BAFFLE MAIN INJECTOR IS AN ALLOWABLE ALTERNATE TO THE BAFFLELESS MAIN INJECTOR | RS009122-1671, RS009122-1681 |
| 2. NO RATIONALE EFFECTED. | BLOCK I Isp IMPROVEMENTS DO NOT EXIST ON 2 POWERHEADS | BLOCK I FLIGHT ENGINES MEET CEI REQUIRMENTS FOR Isp. HOWEVER, CERTAIN FLIGHT MANIFESTS REQUIRE AN INCREASE IN Isp FROM THE BLOCK I FLIGHT ENGINES. THE MAIN INJECTOR PRIMARY AND SECONDARY FACEPLATES WERE MODIFIED TO ENHANCE THE COMBUSTION PROCESS. | RS009122-1671 |
| 3. A205-12 AND A205-13, BLOCK IIA Isp IMPROVEMENTS. | THE BLOCK I FLIGHT ENGINES DO NOT HAVE THE MODIFIED MAIN INJECTOR PRIMARY AND SECONDARY FACEPLATES, ROW 13, FUEL SLEEVES AND NEW V-SEAL | BLOCK I FLIGHT ENGINES MEET CEI REQUIREMENTS FOR Isp | RS009122-1681 |