

**SSM FMEA/CIL
REDUNDANCY SCREEN**

Component Group: Block 1 Joints
CIL Item: L602A-01
Part Number: See Table L602A
Component: Oxidizer System Joints (Phase II+ & ATD Configuration)
FMEA Item: L602A
Failure Mode: Leakage.

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 7/25/00
Change #: 1
Directive #: CCB D ME3-01-5638

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| Phase | Failure / Effect Description | Criticality Hazard Reference |
|-----------|---|--|
| SM 4.1 | Oxidizer leakage into aft compartment. Overpressurization of aft compartment. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A | 1 ME-FC3S, ME-FC3A,C, ME-FC3M |

SSME FMEA/CIL DESIGN

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FAILURE CAUSE: A: Seal failure.

ALL THE OXIDIZER JOINTS NOTED IN THE FMEA USE PRESSURE-ASSISTED SEALS. THE PRESSURE-ASSISTED SEALS ARE A VARIATION OF A "U" SHAPE CROSS-SECTION SEAL RING (1). THE SEALS ARE COMPRESSED DURING THE JOINT ASSEMBLY, WHICH PROVIDES A LOAD AT THE SEAL TIPS TO PROVIDE SEALING CAPABILITY AT LOW PRESSURES. AS THE PRESSURE INCREASES, IT ACTS ON THE "U" SHAPE AND INCREASES THE LOAD TO THE SEAL TIPS AND PROVIDES SEALING CAPABILITY AT THE HIGH SYSTEM PRESSURES. THE COMBINATION OF THE INSTALLATION DEFLECTION AND THE PRESSURE INSIDE OF THE "U" SHAPE PERMITS THE SEALING TIP TO COMPENSATE FOR THE JOINT SEPARATION UNDER SYSTEM PRESSURE. THESE INTERACTIONS PROVIDE FOR LEAK FREE JOINTS. THE SEAL MATERIALS ARE EITHER INCONEL 718, INCONEL X-750, OR A-286. THESE ALLOYS ARE USED FOR THEIR STRENGTH, HEAT TREATABILITY, AND ABILITY TO RETAIN THEIR STRENGTH AT BOTH CRYOGENIC AND ELEVATED TEMPERATURES (2). THE SEALS ARE PLATED OR TEFLON COATED TO PROVIDE A DUCTILE LOW YIELD STRENGTH MATERIAL ON THE SEAL TIP SO THE SEAL WILL CONFORM TO THE SURFACE TOPOGRAPHY ON THE MATING FLANGES. THE MOST COMMON SEALS ARE THE RD261-3014 AND RD261-3017 (VARIOUS SIZES) SEALS. THESE SEALS ARE MADE OF INCONEL 718 AND ARE USED IN JOINTS WITH SERVICE TEMPERATURE REQUIREMENTS FROM -423 DEGREES F TO 1000 DEGREES F, AND PRESSURES UP TO 8,000 PSIG. THEY ARE SILVER PLATED WITH AN INITIAL GOLD UNDERCOAT. THE GOLD UNDERCOAT PREVENTS OXIDIZATION OF THE SUBSTRATE AT TEMPERATURES ABOVE 600 DEGREES F, AND THUS PREVENTS BLISTERING OF THE SILVER PLATING. SILVER IS USED DUE TO ITS LOW YIELD STRENGTH AND DUCTILITY REQUIRED FOR EFFECTING A SEAL, AND ITS CORROSION RESISTANCE (2). SEAL PART NUMBER RD261-3016 IS IDENTICAL TO THE RD261-3014 EXCEPT IT HAS RHODIUM OVERPLATE ON THE SILVER PLATING TO PREVENT THE BONDING OF THE SILVER TO THE MATING FLANGE SURFACE AT TEMPERATURES ABOVE 1000 DEGREES F (2).

WELDED TUBING MAY BE USED TO FABRICATE SEALS LARGER THAN 2.5 INCHES (3). ON THESE TWO SEAL DESIGNS, THE WELDS ARE REQUIRED TO MEET ALL CLASS 1 REQUIREMENTS PER RL10011 (4). ONE SPECIAL SEAL, RS008862, IS USED ON CRYOGENIC JOINTS. THIS SEAL IS OF THE "U" SHAPE CONFIGURATION. HOWEVER, THE SEALING TIP IS WIDER THAN THE PREVIOUSLY DISCUSSED SEALS AND IS COATED WITH TEFLON. THE SEAL MATERIAL IS INCONEL 718. THE TEFLON PROVIDES THE SOFT INTERFACE AT THE SEAL-FLANGE INTERFACE. THE WIDE TIP AND TEFLON COATING PROVIDE THE ADVANTAGE OF BEING MORE FORGIVING OF SMALL SURFACE IMPERFECTIONS, SUCH AS PITS IN ALUMINUM CASTINGS, AND ALSO RESULTS IN A LOWER BEARING PRESSURE WHICH PREVENTS THE SEAL TIP FROM MARKING SOFT ALUMINUM FLANGES. THE SEALS MEET THE LOX COMPATIBILITY REQUIREMENTS (5). SEALS REMOVED FROM BROKEN JOINTS ARE EITHER REPLACED OR REINSPECTED AND REUSED. GENERAL GUIDELINES ARE TO REPLACE SEALS AT ALL STRETCH JOINTS AND OTHER HARD-TO-GET-AT JOINT SEALS. NON-STRETCH JOINT SEALS WITH EASY ACCESS ARE REINSPECTED AND REUSED IF FOUND ACCEPTABLE. SPECIAL SEALS MAY BE RETURNED FOR OVERHAUL REFURBISHING IF DISASSEMBLY INSPECTIONS FIND SCRATCHES OR OTHER DEFECTS (6).

THE RD261-3014 AND RD261-3017 SEALS WERE DVS TESTED IN SIMULATED ENGINE JOINTS AT CRYOGENIC TEMPERATURES. TWO RD261-3014 SEALS WITH OUTSIDE DIAMETERS OF 1.1 AND 3.8 INCHES AND TWO RD261-3017 WITH OUTSIDE DIAMETERS OF 0.8 AND 1.1 INCHES WERE CHILLED TO MINUS 250 +/- 50F AND PRESSURE CYCLED FROM AMBIENT PRESSURE TO 8,970 PSIG FOR 240 CYCLES WHILE DEMONSTRATING THEIR ABILITY TO SEAL (7). IN ADDITION TO THE ABOVE TESTS, SEALS HAVE BEEN SUBJECTED TO STRUCTURAL VERIFICATION AT PRESSURES UP TO TWICE OPERATING PRESSURE AFTER COMPLETION OF 240 PRESSURE CYCLES WHILE STILL MEETING THE LEAKAGE REQUIREMENT (8).

FOUR SPECIAL SMALL CROSS SECTION MACHINED SEALS, RES1248, RES1256, RES1257, ARE USED TO SPACE RESTRICTIONS AT SOME JOINTS. THESE SEALS ARE ALSO PRESSURE-ASSISTED. THEY ARE OF THE "U" SHAPE CONFIGURATION AND ARE MADE OF A-286 OR INCONEL X-750. THE SOFT SEAL INTERFACES ARE EITHER GOLD, SILVER, OR TEFLON.

HIGH CYCLE AND LOW CYCLE FATIGUE LIFE OF THE OXIDIZER SEALS MEET CEI REQUIREMENTS (11). THE MINIMUM FACTORS OF SAFETY FOR THE OXIDIZER SEALS MEET CEI REQUIREMENTS (12). THE SEALS PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH SINCE THEY ARE NOT FRACTURE CRITICAL PARTS (13). THE FMEA/CIL WELDS ARE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH BY THE WELD ASSESSMENT (14). TABLE L602A LISTS ALL FMEA/CIL WELDS AND IDENTIFIES THOSE WELDS IN WHICH 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 (14). SPECIAL PACKAGING REQUIREMENTS ARE SPECIFIED TO PROTECT THE SEALS DURING SHIPMENT OR STORAGE (15).

THE FLANGES ARE DESIGNED TO INTERFACE WITH THE SEAL AND HAVE THE NECESSARY FEATURES TO PROVIDE A LEAK FREE JOINT. THE FLANGE DESIGN SPECIFIES THE REQUIREMENTS FOR SURFACE FLATNESS, SURFACE FINISH, AND THE SEALING SURFACE AREA ON THE FLANGE. THIS ENSURES THAT THE SEAL MATING AREA IS CLOSELY INSPECTED TO VERIFY IT IS FREE OF DEFECTS WHICH WOULD CAUSE LEAKAGE. TYPICALLY, ONE FLANGE HAS A SEAL GROOVE FOR POSITIONING THE SEAL WHILE THE OTHER FLANGE IS FLAT. BOLT HOLE CLEARANCES ARE CONTROLLED BY THE FLANGE DESIGN TO PREVENT EXCESSIVE LATERAL MOTION WITHIN THE JOINT. THE FLANGE

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Prepared: D. Earl
Approved: T. Ngu
Approval Date: 7/25/00
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Design / Document Reference

CONTROLS THE DEFLECTION IN BOTH THE RADIAL AND CIRCUMFERENTIAL DIRECTIONS. RADIAL DEFLECTIONS ARE LARGELY CONTROLLED BY THE THICKNESS OF THE FLANGE WHILE CIRCUMFERENTIAL DEFLECTIONS ARE CONTROLLED BY FLANGE THICKNESS AND BOLTING REQUIREMENTS. THE JOINT DESIGNS HAVE CLOSE BOLT SPACING TO PREVENT UNACCEPTABLE FLANGE BOWING (DEFLECTION) BETWEEN BOLTS. TYPICAL FLANGES WERE USED DURING DVS STATIC SEAL TESTING WHICH CONFIRMED DESIGN REQUIREMENTS USED ON THE ENGINE FLANGES (7) (8) (16). LEAK CHECKS DURING ENGINE BUILD AND AT INTERVALS DURING ENGINE SERVICE HAVE SHOWN THAT THE FLANGES PERFORM SATISFACTORILY AND MAINTAIN JOINT INTEGRITY. THIS HAS BEEN FURTHER DEMONSTRATED BY THE FLANGES ON TWO HIGH TIME ENGINES: ENGINE 2010 WITH 65 STARTS AND 19,903 SECONDS OF HOT FIRE TIME (9), AND ENGINE 2014 WITH 70 STARTS AND 19,102 SECONDS OF HOT FIRE TIME (10).

(1) RD261-3014, RD261-3016, RD261-3017, RES1257, RES1277; (2) RSS-8582; (3) RD261-3014, RD261-3016; (4) RF0004-301; (5) RL10017; (6) RD261-3014, RD261-3016; (7) RSS-514-16; (8) RSS-514-6; (9) 529-143-IL-85-0126; (10) SSME-86-00096; (11) RL00532, CP320R0003B; (12) RSS-8546; (13) NASA TASK 117; (14) RSS-8756; (15) RA0116-082; (16) RSS-514-12

FAILURE CAUSE: B: Loss of bolt preload.

JOINT BOLTING IS AN INTEGRAL PART OF STATIC SEAL JOINTS. THE BOLTING IS DESIGNED TO TAKE INTO CONSIDERATION BOTH THE PRESSURE SEPARATING LOAD AND ALL EXTERNAL LOADS THAT ACT ON THE JOINT. BOLTS ARE SPACED CLOSELY TOGETHER TO MINIMIZE FLANGE DEFLECTION. HIGH STRENGTH BOLTS ARE USED TO PROVIDE THE NECESSARY CLAMPING LOAD WHILE KEEPING THE TOTAL JOINT WEIGHT TO A MINIMUM. THE BOLT MATERIALS ON FLUID SYSTEMS ARE A-286 AND INCONEL 718, WHICH ARE USED FOR THEIR STRENGTH, ELASTIC MODULUS, AND COMPATABILITY WITH ENGINE ENVIRONMENT (1) TEMPERATURES. THE BOLTS OR NUTS ARE NORMALLY COATED WITH DRY-FILM LUBRICANTS OR PLATED TO REDUCE THE TORQUE REQUIRED FOR TIGHTENING AND TO REDUCE THE LOAD RANGE VARIATIONS DUE TO FRICTION. THE FASTENERS (BOLTS AND STUDS) MAY BE INSTALLED INTO THREADED HOLES, LOCKING INSERTS, OR IN NUTS. THE BOLTS ARE LOCKWIRED TO PREVENT BOLT BACKOFF ON THREADED HOLE INSTALLATIONS AND THE SELF-LOCKING INSERTS AND NUTS HAVE DEFORMED THREADS TO PREVENT NUT BACKOFF ON BOLT-NUT INSTALLATIONS. FASTENER INSTALLATION IS CONTROLLED AT ENGINE ASSEMBLY TO ENSURE THAT THE INSTALLATION HAS THE PROPER BOLT LOADING AND NO DAMAGE OCCURS TO EITHER THE FASTENERS OR FLANGES. ON TORQUED INSTALLATIONS THE TORQUE IS APPLIED IN THREE EQUAL STEPS WITH TORQUE AT EACH STEP APPLIED IN A CROSS TORQUEING PROCEDURE (2). ON HIGH PRESSURE JOINT INSTALLATIONS, THE FASTENERS (BOLTS AND STUDS) ARE STRETCHED TO A DRAWING SPECIFIED ELONGATION. THIS OPERATION IS CONTROLLED BY A SPECIFICATION (3) WHICH REQUIRES AN INITIAL TORQUE TO BE APPLIED IN A CROSS TORQUEING PROCEDURE. THE FASTENERS ARE THEN STRETCHED TO A FINAL ELONGATION USING A SPECIAL MACHINE (EXTENSOMETER) AND USING A CROSS TORQUEING PROCEDURE. THE STRETCHING PROCEDURES ARE PERFORMED BY TRAINED AND CERTIFIED PERSONNEL AND WITNESSED BY A CERTIFIED INSPECTOR. BOLTS ARE REQUIRED TO BE LOCKWIRED AFTER INSTALLATION (2) (3). REUSE OF A FASTENER REQUIRES RELUBRICATION AND REINSPECTION FOR GALLING, THREAD DAMAGE, OR WRENCHING ELEMENT DISTORTION. ALL SELF-LOCKING NUTS REQUIRE VERIFICATION OF THE LOCKING FEATURE DURING NUT INSTALLATION (2) (3). THE MATERIALS USED FOR THE WASHERS AT THE JOINT BOLTING ARE SELECTED FOR THEIR COMPRESSIVE YIELD STRENGTH TO PREVENT YIELDING UNDER JOINT OPERATING PRESSURES (1). THE STRETCH FASTENERS WERE USED THROUGHOUT THE STATIC SEAL DVS TESTING ON SIMULATED JOINTS WHICH DEMONSTRATED THE BOLTING DESIGN APPROACH AND THE ABILITY OF THE JOINTS TO MEET THE LEAKAGE REQUIREMENTS (4). LEAK CHECKS DURING ENGINE BUILD AND AT INTERVALS DURING ENGINE SERVICE HAVE SHOWN THAT JOINT INTEGRITY IS SATISFACTORILY MAINTAINED BY THE BOLTING DESIGNS.

(1) RSS-8582; (2) RA0101-002; (3) RL00114; (4) RSS-514-16, RSS-514-12, RSS-514-6

SSME FMEA/CIL
INSPECTION AND TEST

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Prepared: D. Early
 Approved: T. Nguyen
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| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference |
|----------------|-----------------------------|--|---|
| A | SEAL-P/A | | RD261-3014 |
| | SEAL-P/A | | RD261-3016 |
| | SEAL-P/A | | RD261-3017 |
| | TRANSDUCER STATIC SEAL | | RES1277 |
| | MATERIAL INTEGRITY | MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. | RD261-3014 RD261-3016 RD261-3017 RES1277 |
| | | TUBING WELDS ON MATERIALS USED TO FABRICATE SEALS ARE INSPECTED PER SPECIFICATION REQUIREMENTS INCLUDING X-RAY AND PENETRANT INSPECTIONS. | RF0004-301 RL10011 |
| | | HEAT TREAT OF SEALS IS VERIFIED PER DRAWING REQUIREMENTS. | RD261-3014 RD261-3016 RD261-3017 RES1277 |
| | | SEALS ARE PENETRANT INSPECTED PER DRAWING REQUIREMENTS. | RD261-3014 RD261-3016 RD261-3017 RES1277 |
| | PLATING INTEGRITY | SEAL PLATING IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS. | RD261-3014 RD261-3016 RD261-3017 RES1277 RA1609-020 RA1609-001 |
| | SURFACE FINISH | SEAL SURFACE FINISHES ARE VERIFIED PER DRAWING REQUIREMENTS. | RD261-3014 RD261-3016 RD261-3017 RES1277 |
| | CLEANLINESS | SEALS ARE VERIFIED TO BE CLEAN TO PROPELLANT SERVICE LEVEL PER DRAWING REQUIREMENTS. | RD261-3014 RD261-3016 RD261-3017 RES1277 |
| | SEAL, P/A, TEFLON COATED | | RS008862 |
| | MATERIAL INTEGRITY | MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. HEAT TREAT OF SEAL IS VERIFIED PER DRAWING REQUIREMENT. SEAL IS PENETRANT INSPECTED PER DRAWING REQUIREMENTS. | RS008862 RS008862 RS008862 |
| | TEFLON COATING INTEGRITY | TEFLON COATING IS VERIFIED PER DRAWING REQUIREMENTS. | RS008862 |

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| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference |
|----------------|---|---|---------------------------------|
| A | SURFACE FINISH | SEAL SURFACE FINISHES ARE VERIFIED PER DRAWING REQUIREMENTS. | RS008862 |
| | CLEANLINESS | SEALS ARE VERIFIED TO BE CLEAN TO PROPELLANT SERVICE LEVEL PER DRAWING REQUIREMENTS. | RS008862 |
| | SEAL, MINIATURE | | RES1248 |
| | SEAL, INTERNAL PRESS. | | RES1256 |
| | SEAL, INTERNAL PRESS. | | RES1257 |
| | MATERIAL INTEGRITY | MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. | RES1248 RES1256 RES1257 |
| | TEFLON COATING INTEGRITY | TEFLON COATING IS VERIFIED PER DRAWING REQUIREMENTS. | RES1257 |
| | | LOX COMPATIBILITY OF TEFLON COATING IS VERIFIED. | RES1257 |
| | PLATING INTEGRITY | SEAL PLATING IS VERIFIED PER DRAWING REQUIREMENTS. | RES1248 RES1256 RES1257 |
| | SEALING SURFACE INTEGRITY | THE SEALING SURFACE FINISH IS VERIFIED PER DRAWING REQUIREMENTS. | RES1248 RES1256 RES1257 |
| | CLEANLINESS | SEALS ARE VERIFIED TO BE CLEAN TO PROPELLANT SERVICE LEVEL PER DRAWING REQUIREMENTS. | RS010161 RS010180 RES1257 |
| | FLANGE SEALING SURFACE INTEGRITY | ALL FLANGE SEALING SURFACES ARE INSPECTED FOR SURFACE FINISH, WIDTH, AND LOCATION PER DRAWING REQUIREMENTS. | SEE TABLE L602A-CIL |
| | | SEAL GROOVE DIMENSIONS ARE VERIFIED ON APPLICABLE JOINT FLANGES PER DRAWING REQUIREMENTS. | SEE TABLE L602A-CIL |
| B | BOLT | | RD111-1009 |
| | BOLT | | RD111-1011 |
| | BOLT | | RD111-4008 |
| | BOLT | | RD111-4010 |
| | BOLT | | RD111-4022 |
| | BOLT | | RD111-4100 |
| | BOLT | | RD111-4101 |
| | BOLT | | RD111-4102 |
| | BOLT | | RD111-4103 |
| | BOLT | | RD111-4105 |
| | NUT | | RS007837 |
| | NUT | | RD114-8010 |
| | NUT | | RD114-8017 |
| | NUT | | RD114-1019 |
| BOLT PRELOAD | BOLT AND NUT FINAL TORQUES ARE VERIFIED PER DRAWING REQUIREMENTS. | SEE TABLE L602A-CIL | |

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| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference | |
|-----------------|--|---|--|--|
| B | BOLT PRELOAD | STRETCH BOLT AND STUD LENGTHS ARE INSPECTED PRIOR TO INSTALLATION PER DRAWING REQUIREMENTS. | SEE TABLE L602A-CIL | |
| | | FINAL STRETCH BOLT AND STUD LENGTHS ARE VERIFIED PER DRAWING REQUIREMENTS. | SEE TABLE L602A-CIL | |
| | | PROPER LOCK WIRING OF BOLTS IS VERIFIED. | SEE TABLE L602A-CIL | |
| | | NEW SELF-LOCKING NUTS ARE LOT SAMPLE ACCEPTANCE TESTED TO ASSURE BREAK AWAY TORQUES AND LOCKING FEATURES ARE MAINTAINED AFTER MULTIPLE INSTALLATION AND REMOVAL CYCLES. | RB0170-156 RD114-8010 | |
| | BOLT LUBRICATION | BOLT DRY-FILM LUBRICATION IS VERIFIED PER DRAWING REQUIREMENTS. | | RD111-1009 RD111-1011 RD111-4008 RD111-4010 RD111-4022 RD111-4100 RD111-4101 RD111-4102 RD111-4103 RD111-4105 RS007837 |
| | | | | RD114-8010 RD114-8017 |
| | | | | RD114-1019 |
| | | | | |
| | | | | |
| | | | | |
| NUT LUBRICATION | NUT DRY FILM LUBRICATION IS VERIFIED PER DRAWING REQUIREMENTS. | | RD114-8010 RD114-8017 | |
| | | SILVER PLATING ON NOTED NUT IS INSPECTED PER DRAWING REQUIREMENTS. | RD114-1019 | |
| ALL CAUSES | LEAK TESTS | THE ENGINE ASSEMBLY ABOVE THE HEAT SHIELD IS BAGGED AND HELIUM LEAK TESTED WHICH VERIFIES NO EXCESSIVE JOINT LEAKAGE. | RL00712 | |
| | | ALL JOINTS ARE LEAK TESTED PRIOR TO HOT FIRE. | RL00050-04 | |
| | | ALL INTERCONNECT JOINTS ARE LEAK TESTED AFTER HOT FIRE. | RL00056-06 RL00056-07 | |
| | | COMPONENT JOINTS ARE LEAK TESTED DURING FUNCTIONAL AND PROOF PRESSURE TESTING. | SEE TABLE L602A-CIL | |
| | | THE GOX SYSTEM JOINTS ARE LEAK TESTED PRIOR TO EACH FLIGHT (LAST GOX SYSTEM TEST). | OMRSD V41BP0.010 | |
| | | JOINTS ARE LEAK TESTED WHENEVER DISTURBED. | OMRSD V41GEN.555 OMRSD V41BP0.010 | |
| | | ALL OXIDIZER JOINTS WITHIN THE AFT COMPARTMENT (EXCEPT INSTRUMENTATION JOINTS AND JOINTS DOWNSTREAM OF ANTI-FLOOD VALVE) ARE SIGNATURE LEAK TESTED PRIOR TO EACH FLIGHT. CONTINGENCY REQUIREMENTS FOR VIOLATED PROPELLANT JOINTS, AFTER SIGNATURE LEAK TEST, WITH 4 FASTENERS OR LESS ARE BUBBLE SOAP AND MASS SPECTROMETER LEAK TESTED PRIOR TO EACH FLIGHT. (LAST TEST) | OMRSD S00000.950 OMRSD V41GEN.555 MF0001-003 | |
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Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)

Reference: NASA letter SA21/88/308 and Rocketdyne letter 88RC09761.

Operational Use: Not Applicable.

**SSMF MEA/CIL
CIL SYSTEM JOINTS**

Component Group: Block 1 Joints
Item Name: Oxidizer System Joints (Phase II+ & ATD Configuration)
Item Number: L602A

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 7/25/00
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| Joint | Location | Seal Part Number | Seal Part Number Description | Torque or Stretch | Locking Feature | Assembly Drawing |
|--------|--|------------------|--|-------------------|-----------------|------------------|
| O1 | LPOTP RS007801 TO ORBITER INTERFACE | N/A | | N/A | N/A | N/A |
| O1.1 | LPOTP RS007801 TO LPOTP SHAFT SPEED TRANSDUCER RS007802 | RES1277 | PRESSURE ACTUATED - SILVER PLATE OVER INCO X750. | TORQUE | LOCKWIRE | RS007007 |
| O1.2 | LPOTP TURBINE DRIVE MANIFOLD RS007802 TO COVER RS007836 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007002 |
| O1.3 | LPOTP TURBINE DRIVE MANIFOLD RS007802 TO COVER RS007836 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007002 |
| O2 | LPOTP RS007801 TO LPOTP DISCHARGE DUCT RS007015 | RS008862 | PRESSURE ACTUATED - TEFLON COATED INCO 718 | STRETCH | LOCKWIRE | RS007003 |
| O2.2 | LPOTP DISCHARGE DUCT RS007015 TO LPOTP DISCHARGE PRESSURE TRANSDUCER LINE RS007365 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007007 |
| O2.2.1 | LPOTP DISCHARGE PRESSURE TRANSDUCER LINE RS007365 TO LPOTP DISCHG PRESS TRANSD RES7001 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007007 |
| O2.3 | LPOTP DISCHARGE DUCT RS007015 TO BOSS RS007167 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007007 |
| O2.4 | LPOTP DISCHARGE DUCT RS007015 TO BOSS RS007167 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007003 |
| O2.5 | LPOTP DISCHARGE DUCT RS007015 TO ACCUMULATOR INLET FLOW BAFFLE R0012666 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O2.6 | ACCUMULATOR INLET FLOW BAFFLE R0012666 TO POGO ACCUMULATOR RS007280 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O2.7 | POGO ACCUMULATOR RS007280 TO BOSS RS007167 PLATE | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O3 | LPOTP DISCHARGE DUCT RS007015 TO HPOTP 4750000 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007003 |
| O3.1 | HPOTP 4750000 TO BOSS RS009528 PLUG | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007002 |
| O3.2 | HPOTP 4750000 TO BOSS RS009528 PLUG | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007002 |
| O3.3 | HPOTP 4750000 TO BOSS R0012132 PLUG | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007002 |
| O4 | HPOTP 4750000 TO LPOTP TURBINE DRIVE DUCT RS007035 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007003 |

* Unnumbered Component Joint

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| Joint | Location | Seal Part Number | Seal Part Number Description | Torque or Stretch | Locking Feature | Assembly Drawing |
|--------|---|------------------|--|-------------------|-----------------|------------------|
| O5 | LPOTP RS007801 TO ATD ORIFICE R037863 (BLOCK I ONLY) | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007003 |
| O5 | LPOTP RS007801 TO LPOTP TURBINE DRIVE DUCT RS007035 (BLOCK IIA ONLY) | RD261-3014 | PRESSURE ACTUATED - SILVER OVER GOLD PLATE INCO 718 | STRETCH | LOCKWIRE | RS007003 |
| O5.1 | LPOTP TURBINE DRIVE DUCT RS007035 TO ATD ORIFICE R037863 (BLOCK I ONLY) | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007003 |
| O6 | HPOTP 4750000 TO HIGH PRESSURE OXIDIZER DUCT RS007021 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007004 |
| O6.1 | HIGH PRESSURE OXIDIZER DUCT RS007021 TO HPOTP DISCHARGE PRESSURE TRANSDUCER LINE R0019550 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007007 |
| O6.1.1 | HPOTP DISCHARGE PRESSURE TRANSDUCER LINE R0019550 TO HPOTP DISCHG PRESS TRANSD RES7001 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007007 |
| O6.2 | HIGH PRESSURE OXIDIZER DUCT RS007021 TO BOSS COVER RS007106 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007007 |
| O7 | HIGH PRESSURE OXIDIZER DUCT RS007021 TO MOV RS008255 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007004 |
| O7.1 | MOV RS008255 TO MAIN INJECTOR ASI LINE RS007152 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O8 | MOV RS008255 TO MAIN INJECTOR INLET R0017621 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007004 |
| O8.2 | MAIN INJECTOR OXIDIZER MANIFOLD RS009124 TO BOSS RS007167 PLATE | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007002 |
| O8.3 | MAIN INJECTOR OXIDIZER MANIFOLD RS009124 TO MCC OXIDIZER INJECTOR TEMP TRANSD RES7002 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007007 |
| O8.4 | MAIN INJECTOR OXIDIZER INLET R0017621 TO MCC DOME PURGE LINE RS007103 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O9 | HIGH PRESSURE OXIDIZER DUCT RS007021 TO PREBURNER PUMP SUPPLY DUCT RS007029 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007004 |
| O9.1 | PREBURNER PUMP SUPPLY DUCT RS007029 TO PLATE RS007162 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O10 | PREBURNER PUMP SUPPLY DUCT RS007029 TO HPOTP 4750000 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007004 |
| O11 | HPOTP 4750000 TO OPB OXIDIZER SUPPLY DUCT RS007032 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007004 |
| O11.1 | OPB OXIDIZER SUPPLY DUCT RS007032 TO PBP DISCHARGE PRESSURE TRANSDUCER LINE RS007363 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007007 |

* Unnumbered Component Joint

Component Group: Block 1 Joints
 Item Name: Oxidizer System Joints (Phase II+ & ATD Configuration)
 Item Number: L602A

Prepared: D. Earl
 Approved: T. Ngu,
 Approval Date: 7/25/00
 Change #: 2
 Directive #: CCBD ME3-01-5638
 Page: 3 of 6

| Joint | Location | Seal Part Number | Seal Part Number Description | Torque or Stretch | Locking Feature | Assembly Drawing |
|---------|--|------------------|--|-------------------|-----------------|------------------|
| O11.1.1 | PBP DISCHARGE PRESSURE TRANSDUCER LINE RS007363 TO PBP DISCHG PRESS TRANSD RES7001 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007007 |
| O11.1.2 | PBP DISCHARGE PRESSURE TRANSDUCER LINE RS007363 TO PBP DISCHG TEMP TRANSD RES7002 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007007 |
| O12 | OPB OXIDIZER SUPPLY DUCT RS007032 TO OPOV RS008258 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007004 |
| O12.1 | OPOV RS008258 TO OPB OXIDIZER PURGE ADAPTER RS007258 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O12.2 | OPB OXIDIZER PURGE ADAPTER RS007258 TO OPB ASI OXIDIZER SUPPLY LINE RS007186 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O12.1.2 | OPB ASI OXIDIZER SUPPLY LINE RS007186 TO OPB ASI BYPASS LINE RS009529 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O12.1.3 | OPB ASI OXIDIZER SUPPLY LINE RS007186 TO OPB ASI INLET RS009086 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O12.1.4 | OPB ASI OXIDIZER SUPPLY LINE RS007186 TO OPB ASI PURGE LINE R0010828 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O12.3 | OPB PURGE LINE RS007134 TO OPB OXIDIZER PURGE ADAPTER RS007258 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O13 | OPOV RS008258 TO OPB INLET RS009014 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007004 |
| O14 | FPB OXIDIZER SUPPLY DUCT RS007031 TO OXIDIZER BLEED LINE RS007041 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007004 |
| O14.1 | OXIDIZER RECIRCULATION BLEED LINE RS007297 TO OXIDIZER BLEED FLEX LINE RES1221 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007003 |
| O15 | OXIDIZER BLEED FLEX LINE RES1221 TO ORBITER INTERFACE | N/A | | N/A | N/A | N/A |
| O16 | FPOV RS008257 TO FPB OXIDIZER SUPPLY DUCT RS007031 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007004 |
| O16.1 | FPOV RS008257 TO FPB OXIDIZER PURGE ADAPTER RS007259 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O16.1.2 | FPB ASI OXIDIZER SUPPLY LINE R0018051 TO FPB RS009529 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O16.1.3 | FPB ASI OXIDIZER SUPPLY LINE R0018051 TO FPB ASI RS009086 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O16.1.4 | FPB ASI PURGE LINE R0010747 TO FPB ASI OXIDIZER SUPPLY LINE R0018051 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |

* Unnumbered Component Joint

Component Group: Block 1 Joints
Item Name: Oxidizer System Joints (Phase II+ & ATD Configuration)
Item Number: L602A

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 7/25/00
Change #: 2
Directive #: CCBD ME3-01-5638
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| Joint | Location | Seal Part Number | Seal Part Number Description | Torque or Stretch | Locking Feature | Assembly Drawing |
|---------|---|------------------|--|-------------------|-----------------|------------------|
| O16.2 | FPB OXIDIZER PURGE ADAPTER RS007259 TO FPB ASI OXIDIZER SUPPLY LINE R0018051 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007004 |
| O16.3 | FPB OXIDIZER PURGE ADAPTER RS007259 TO FPB PURGE LINE RS007135 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O17 | FPOV RS008257 TO FPB INLET R0017437 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007005 |
| O18 | PB PUMP INLET DUCT RS007029 TO HEAT EXCHANGER SUPPLY DUCT RS007083 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007005 |
| O18.1 | AFV RS007083 TO TEST PORT COVER R0019128 | RES1257 | PRESSURE ACTUATED - TEFLON COATED A286. | TORQUE | LOCKWIRE | RS007005 |
| O19 | HEAT EXCHANGER SUPPLY DUCT RS007083 TO HEAT EXCHANGER R039060 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | R0018001 |
| O19.0.1 | HEAT EXCHANGER R039060 TO HEAT EXCHANGER INLET MANIFOLD R039052 | RD261-3019 | PRESSURE ACTUATED - RHODIUM PLATE OVER SILVER OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | R0018001 |
| O19.1 | HEAT EXCHANGER INLET MANIFOLD R039052 TO HEAT EXCHANGER BYPASS ORIFICE R035519 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | R0018001 |
| O19.2 | HEAT EXCHANGER BYPASS ORIFICE R035519 TO HEAT EXCHANGER BYPASS LINE/DUCT ASSY R0018001 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | R0018001 |
| O20 | HEAT EXCHANGER R039060 TO HEAT EXCHANGER OUTLET MIXER R039053 | RD261-3019 | PRESSURE ACTUATED - RHODIUM PLATE OVER SILVER OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | R0018001 |
| O20.0.1 | HEAT EXCHANGER OUTLET MIXER R039053 TO HEAT EXCHANGER DUCT R0018001 | RD261-3019 | PRESSURE ACTUATED - RHODIUM PLATE OVER SILVER OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | R0018001 |
| O20.1 | HEAT EXCHANGER DUCT R0018001 TO HEAT EXCHANGER OUTLET PRESSURE TRANSDUCER LINE RS007367 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O20.1.1 | HEAT EXCHANGER OUTLET PRESSURE TRANSDUCER LINE RS007367 TO OXID TANK PRESS TRANSD RES7001 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O20.2 | HEAT EXCHANGER DUCT R0018001 TO OXIDIZER TANK PRESSURANT DUCT RS007016 | RD261-3016 | PRESSURE ACTUATED - RHODIUM PLATE OVER SILVER OVER GOLD OVER INCO 718. | STRETCH | LOCKWIRE | RS007005 |
| O21 | OXIDIZER TANK PRESSURANT DUCT RS007016 TO ORBITER INTERFACE | N/A | | N/A | N/A | RS007005 |
| O23 | HEAT EXCHANGER DUCT R0018001 TO POGO GOX SUPPLY LINE RS007285 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |

* Unnumbered Component Joint

Component Group: Block 1 Joints
 Item Name: Oxidizer System Joints (Phase II+ & ATD Configuration)
 Item Number: L602A

Prepared: D. Early
 Approved: T. Nguyn
 Approval Date: 7/25/00
 Change #: 2
 Directive #: CCBD ME3-01-5638

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| Joint | Location | Seal Part Number | Seal Part Number Description | Torque or Stretch | Locking Feature | Assembly Drawing |
|-------|--|------------------|--|-------------------|-----------------|------------------|
| O24 | GOX CONTROL VALVE RS007147 TO POGO GOX SUPPLY LINE RS007285 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O24.1 | GOX CONTROL VALVE RS007147 TO RIV OVERRIDE LINE RS007369 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O24.2 | RIV RS010161 TO RIV OVERRIDE LINE RS007369 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O25 | GOX CONTROL VALVE RS010142 TO POGO PRECHARGE LINE RS007284 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O26 | POGO PRECHARGE LINE RS007284 TO ACCUMULATOR SUPPLY LINE RS007352 AT GCV | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O26.1 | HPV RS010182 TO POGO PRECHARGE LINE RS007284 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O26.2 | HPV RS010181 TO POGO PRECHARGE PRESSURE TRANSDUCER RES7001 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O27 | ACCUMULATOR SUPPLY LINE RS007283 TO POGO ACCUMULATOR RS007280 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O28 | POGO ACCUMULATOR RS007280 TO ADAPTER RS007298 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O29 | RIV RS010161 TO ADAPTER RS007298 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O30 | OXIDIZER BLEED LINE RS007041 TO OXIDIZER RECIRCULATION BLEED LINE RS007297 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| O31 | OXIDIZER RECIRCULATION BLEED LINE RS007297 TO POGO RECIRCULATION LINE RS010439 | RD261-3017 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | TORQUE | LOCKWIRE | RS007005 |
| * | MOV HOUSING RS008087 TO BELLOWS RS008211 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS008255 |
| * | MOV HOUSING RS008087 TO CAP RS008272 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS008255 |
| * | FPOV HOUSING RS008236 TO BELLOWS RS008230 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS008257 |
| * | FPOV HOUSING RS008236 TO CAP RS008266 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS008257 |
| * | OPOV HOUSING RS008236 TO BELLOWS RS008230 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS008258 |
| * | AFV HOUSING R0019121 TO CAP R0019122 | RES1257 | PRESSURE ACTUATED - TEFLON COATED A286. | TORQUE | LOCKWIRE | RS007083 |

* Unnumbered Component Joint

Component Group: Block 1 Joints
 Item Name: Oxidizer System Joints (Phase II+ & ATD Configuration)
 Item Number: L602A

Prepared: D. Early
 Approved: T. Nguyen
 Approval Date: 7/25/00
 Change #: 2
 Directive #: CCBD ME3-01-5638
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| Joint | Location | Seal Part Number | Seal Part Number Description | Torque or Stretch | Locking Feature | Assembly Drawing |
|-------|---|------------------|--|-------------------|-----------------------|----------------------|
| * | HPOTP HOUSING 4751308 TO PBP VOLUTE 4751136 | RD261-3014 | PRESSURE ACTUATED - SILVER PLATE OVER GOLD OVER INCO 718 | STRETCH | LOCKWIRE | RS007701 |
| * | RIV HOUSING RS010162 TO SEAT RS010170 | RES1248 | PRESSURE ACTUATED - GOLD PLATE OVER A286. | TORQUE | LOCKWIRE & LKG INSERT | RS007005 RS010161 |
| * | HPV BODY RS010182 TO SEAT RS010183 | RES1256 | PRESSURE ACTUATED - GOLD PLATE OVER A286. | TORQUE | LOCKWIRE | RS010180 |
| * | HPV HOUSING RS010181 TO SEAT RS010183 | RES1256 | PRESSURE ACTUATED - GOLD PLATE OVER A286. | TORQUE | LOCKWIRE | RS010180 |

* Unnumbered Component Joint

SSMF IEA/CIL
WELD JOINTS

Component Group: Block 1 Joints
 CIL Item: L602A
 Part Number: See Table L602A
 Component: Oxidizer System Joints (Phase II+ & ATD Configuration)
 FMEA Item: L602A

Prepared: D. Early
 Approved: T. Nguyen
 Approval Date: 7/25/00
 Change #: 1
 Directive #: CCBD ME3-01-5638
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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 | |
| SEAL | RD261-3014 | 1 | GTAW | I | | | | |
| SEAL | RD261-3016 | 1 | GTAW | I | | | | |