

SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group: Ducts and Lines
CIL Item: K554-01, K555-01
Part Number: R046294, R046284
Component: Large Throat MCC Inlet and Outlet Elbows
FMEA Item: K554, K555
Failure Mode: External rupture.

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 7/25/00
Change #: 3
Directive #: CCBD ME3-01-5638

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| Phase | Failure / Effect Description | Criticality Hazard Reference |
|------------|---|-------------------------------------|
| SMC 4.1 | Leakage into the aft compartment will cause overpressurization. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A | 1 ME-B5S, ME-B5M, ME-B5A,C |

**SSME FMEA/CIL
DESIGN**

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Design / Document Reference

FAILURE CAUSE: A: Parent material failure or weld failure.

THE LTMCC INLET ELBOW IS MANUFACTURED FROM INCONEL 718, HEAT TREATED AFTER ASSEMBLY (1) (2) (3). ITS STRENGTH AFTER HEAT TREAT IS THE PRIMARY REASON FOR THIS SELECTION (4). THE OPERATING ENVIRONMENT FOR THE INLET ELBOW IS BELOW THE TEMPERATURE WHERE 718 BECOMES SUSCEPTIBLE TO HYDROGEN EMBRITTLEMENT (4). THE INLET MANIFOLD ELBOW IS FORMED FROM TUBING TO PRODUCE A CONSISTENT PART CONFIGURATION. INTEGRAL TRANSITION RINGS AT THE ELBOW AND FLANGE JOINTS ARE DESIGNED WITH INCREASED MATERIAL THICKNESS (1). THE LTMCC OUTLET ELBOW IS INVESTMENT CAST FROM JBK-75 MATERIAL AND SOLUTION TREATED (ANNEALED) PER SPECIFICATION (5)(6). JBK-75 WAS SELECTED FOR ITS CASTABILITY AND RESISTANCE TO HYDROGEN EMBRITTLEMENT (7). THE CAST PROCESS AND QUALITY REQUIREMENTS ARE CONTROLLED PER SPECIFICATION (8). EACH CASTING IS HOT ISOSTATIC PRESSED (HIP) (9) AGE HARDENED (6) AND PRESSURE TESTED PER SPECIFICATION AND DRAWING REQUIREMENTS (5). HIGH AND LOW CYCLE FATIGUE LIFE OF THE MANIFOLDS MEET CEI REQUIREMENTS (10). THE LTMCC PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH BY THE WELDING/CASTING ASSESSMENT. THE FMEA/CIL WELDS ARE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH BY THE WELD ASSESSMENT (11). TABLE K554, 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. PRIMARY STRESS FACTORS OF SAFETY MEET CEI REQUIREMENTS FOR THE LTMCC (12).

(1) R046294; (2) RB0170-153; (3) RA0611-020; (4) RSS-8754-8; (5) R046284; (6)RB0160-080; (7) 572-K; (8) RA1614-001; (9) RL00368; (10) RL00532, CP320R0003B; (11) RSS-88756; (12) CP320R0003B

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INSPECTION AND TEST

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| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference |
|----------------|-----------------------------|---|--|
| A | INLET ELBOW | | R046294 |
| | OUTLET ELBOW | | R046284 |
| | MATERIAL INTEGRITY | MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS. | R046294 R046284 |
| | | INTEGRALLY CAST TEST SPECIMENS ARE EVALUATED PER SPECIFICATION . | RB0160-080 R046284 RB0170-153 R046294 |
| | | RADIOGRAPHIC INSPECTION OF CAST OUTLET ELBOW MATERIAL IS PERFORMED PER DRAWING REQUIREMENTS. | RA0115-006 |
| | HEAT TREAT | HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS. | RB0160-080 RA0611-020 |
| | | HOT ISOSTATIC PRESSING IS APPLIED PER SPECIFICATION REQUIRMENTS. | RL00368 |
| | | PROCESS CONTROL IS DEFINED PER SPECIFICATION REQUIREMENTS. | RA1614-001 |
| | | ELBOWS ARE PROOF PRESSURE TESTED, LEAK TESTED AND PENETRANT INSPECTED AFTER PROOF PER DRAWING REQUIREMENTS. | R046294 R048284 RA0115-116 |

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.

SSME I A/CIL
WELD JOINTS

Component Group: Ducts and Lines
 CIL Item: K554
 Part Number: R046294
 Component: Large Throat MCC Inlet and Outlet Elbows
 FMEA Item: K554, K555

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 Approved: T. Nguyen
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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 | |
| INLET ELBOW | R046294 | 1,2 | GTAW | I | | | | |