# SSME FMEA/CIL
# REDUNDANCY SCREEN

| | | | |
|---|---|---|---|
| **Component Group:** | **Ducts and Lines** | **Prepared:** | **D. Early** |
| **CIL Item:** | **K213-01** | **Approved:** | **T. Nguyen** |
| **Part Number:** | **RS007041** | **Approval Date:** | **7/25/00** |
| **Component:** | **Oxidizer Bleed Line** | **Change #:** | **1** |
| **FMEA Item:** | **K213, K214, N500** | **Directive #:** | **CCBD ME3-01-5638** |
| **Failure Mode:** | **Fails to contain oxidizer.** | **Page:** | **1 of 1** |

| Phase | Failure / Effect Description | Criticality Hazard Reference |
|---|---|---|
| PSMCD 4.1 | Oxidizer leakage into aft compartment. Overpressurization of aft compartment. Loss of vehicle.<br><br>Redundancy Screens: SINGLE POINT FAILURE: N/A | 1 ME-C3P,D, ME-C3S, ME-C3M, ME-C3A,C |

# SSME FMEA/CIL
# DESIGN

| | | | |
|---|---|---|---|
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| | | **Page:** | 1 of 1 |

Design / Document Reference

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

THE LINE ASSEMBLY (1) IS MANUFACTURED UTILIZING 321 CRES FOR THE TUBE. THE FLANGE AND VALVE HOUSING MATERIALS ARE INCONEL 718. THE ADAPTER MATERIAL IS INCONEL 625. 321 CRES WAS SELECTED BECAUSE OF ITS STRENGTH, GENERAL CORROSION RESISTANCE, AND STRESS CORROSION RESISTANCE (2). INCONEL 718 WAS SELECTED FOR ITS STRENGTH, RESISTANCE TO STRESS CORROSION, CORROSION RESISTANCE, HIGH/LOW CYCLE FATIGUE CHARACTERISTICS, AND WELDABILITY (2). INCONEL 625 WAS SELECTED FOR ITS WELDABILITY, FORMABILITY, RESISTANCE TO STRESS CORROSION CRACKING, AND CORROSION RESISTANCE (2). INCONEL 625 BAR POSSESSES THE REQUIRED STRENGTH WITHOUT REQUIRING HEAT TREAT. INCONEL 718 IS HEAT TREATED TO DEVELOP FULL MATERIAL STRENGTH AND HARDNESS. ALL MATERIALS USED IN THE LINE FABRICATION ARE LOX COMPATIBLE (2). FLANGE SECTIONS INCORPORATE RADIUS JOINTS TO REDUCE STRESS CONCENTRATIONS. OFFSET LIMIT REQUIREMENTS ARE ESTABLISHED TO REDUCE STRESS CONCENTRATIONS AND IMPROVE WELD GEOMETRY. TUBING STOCK IS DRAWN TO MAINTAIN SURFACE REGULARITY. INSTALLATION IS CONTROLLED FOR ANGULARITY AND OFFSET PER SPECIFICATION REQUIREMENTS (3). MINIMUM FACTORS OF SAFETY FOR THE LINE MEET CEI REQUIREMENTS (4). HIGH AND LOW CYCLE FATIGUE LIFE FOR THE LINE MEET CEI REQUIREMENTS (5). THE LINE ASSEMBLY HAS COMPLETED PRESSURE CYCLE AND ULTIMATE PRESSURE DVS TESTING (6). THE LINE ASSEMBLY PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH, SINCE THEY ARE NOT FRACTURE CRITICAL PARTS (7). TABLE K213 LISTS ALL THE 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. THESE WELDS HAVE BEEN ASSESSED AS ACCEPTABLE FOR FLIGHT BY RISK ASSESSMENT (8).

(1) RS007041; (2) RSS-8582; (3) RA1102-006; (4) RSS-8546, CP320R0003B; (5) RL00532, CP320R0003B; (6) SSME-81-1054; (7) NASA TASK 117; (8) RSS-8756

# SSME FM /CIL
# INSPECTION ..ND TEST

**Component Group:** Ducts and Lines
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**Part Number:** RS007041
**Component:** Oxidizer Bleed Line
**FMEA Item:** K213, K214, N500
**Failure Mode:** Fails to contain oxidizer.

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



| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference |
|---|---|---|---|
| A | LINE | | RS007041 |
| | MATERIAL INTEGRITY | MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. | RS007041 |
| | HEAT TREAT | HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS. | RA0611-020 |
| | SURFACE FINISH | DETAILS ARE PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS. | RA0115-116 |
| | 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<br>RA0607-094<br>RA0115-116<br>RA0115-006<br>RA1115-001<br>RA0115-127 |
| | ASSEMBLY INTEGRITY | THE ASSEMBLY IS PROOF PRESSURE TESTED PER DRAWING REQUIREMENTS. | RS007041 |
| | FLIGHT FLOW TESTING | THE EXTERNAL SURFACE IS VISUALLY INSPECTED PRIOR TO EACH LAUNCH. | OMRSD V41BU0.030 |
| | | A HELIUM SIGNATURE LEAK TEST IS PERFORMED PRIOR TO EACH LAUNCH. (LAST TEST) | OMRSD S00000.950 |

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 FMEA/CIL
# WELD JOINTS

| | | | |
|---|---|---|---|
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| 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 |
|---|---|---|---|---|---|---|---|---|
| LINE | RS007041 | 1-2 | GTAW | I | X | X | | |
| LINE | RS007041 | 3 | GTAW | I | X | | | |