

SSME EA/CIL  
**REDUNDANCY SCREEN**

Component Group: Igniters and Sensors  
CIL Item: J303-AA-03, J304-AA-03  
Component: HPOTP Turbine Discharge Temp Thermocouple Sensors (G3.1, G3.2)  
Part Number: RE1751, RE1751  
Failure Mode: Leakage into sensor housing.

Prepared: M. Oliver  
Approved: T. Nguyen  
Approval Date: 3/30/99  
Change #: 2  
Directive #: CCBD ME3-01-4994  
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| Phase      | Failure / Effect Description  | Criticality<br>Hazard Reference |
|------------|---|---------------------------------|
| SMC<br>4.1 | Leakage results in housing failure. Overpressurization of aft compartment. Loss of vehicle.<br><br>Redundancy Screens: SINGLE POINT FAILURE: N/A. | 1<br>ME-D35 A,M,C               |

**SSME FMEA/CIL**  
**DESIGN**

Component Group: Igniters and Sensors  
CIL Item: J303-AA-03, J304-AA-03  
Component: HPOTP Turbine Discharge Temp Thermocouple Sensors (G3.1, G3.2)  
Part Number: RE1751, RE1751  
Failure Mode: Leakage into sensor housing.

Prepared: M. Oliver  
Approved: T. Nguyen  
Approval Date: 3/30/99  
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Design / Document Reference

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**FAILURE CAUSE: ALL CAUSES**

THE HOT GAS TEMPERATURE SENSOR PROBE HOUSING IS MADE FROM INCONEL 625. INCONEL 625 WAS SELECTED FOR ITS TENSILE STRENGTH, RESISTANCE TO GENERAL CORROSION, WELDABILITY TO 300 SERIES CRES, AND RESISTANCE TO STRESS CORROSION CRACKING (1), (2). HYDROGEN ENVIRONMENT EFFECTS ARE NOT CONSIDERED A PROBLEM UNDER THESE CONDITIONS OF USE (1). THE SHIELD IS GAS TUNGSTEN ARC WELDED TO THE PROBE HOUSING (3). PROCESSES USED FOR INTERNAL PROBE BRAZING AND HOUSING WELDING ARE CONTROLLED BY SPECIFICATION (3).

THE SENSORS ARE A VENDOR ITEM, DRAWING SPECIFICATION AND MANUFACTURING PROCESSES ARE CONTROLLED BY ROCKETDYNE (3). ALL SENSOR DESIGNS ARE SUBJECT TO A CRITICAL DESIGN REVIEW. ANY DESIGN CHANGES ARE RE-REVIEWED (3). SENSORS HAVE COMPLETED USEFUL LIFE TESTING (3), INCLUDING VIBRATION TESTING (3). THE MINIMUM FACTORS OF SAFETY MEET CEI REQUIREMENTS (4). THE SENSORS ARE ANALYZED FOR HIGH CYCLE FATIGUE AND LOW CYCLE FATIGUE LIFE AND MEET CEI REQUIREMENTS (5)

(1) RSS-8562; (2) MSFC-SPEC-522; (3) RC1751; (4) RSS-8546, CP320R0003B; (5) RL00532 CP320R0003B

**SSME FL /CIL  
INSPECTION AND TEST**

Component Group: Igniters and Sensors  
 CIL Item: J303-AA-03, J304-AA-03  
 Component: HPOTP Turbine Discharge Temp Thermocouple Sensors (G3.1, G3.2)  
 Part Number: RE1751, RE1754  
 Failure Mode: Leakage into sensor housing.

Prepared: M. Oliver  
 Approved: T. Nguyen  
 Approval Date: 3/30/99  
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| Failure Causes | Significant Characteristics             | Inspection(s) / Test(s)  | Document Reference                   |
|----------------|---|--|--------------------------------------|
| ALL CAUSES     | TEMPERATURE<br>TRANSDUCER               |  | RE1751                               |
|                | MATERIAL INTEGRITY                      | MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.   | RC1751                               |
|                | BRAZE INTEGRITY                         | BRAZING IS INSPECTED PER SPECIFICATION REQUIREMENTS.   |                                      |
|                | 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.   |                                      |
|                | ASSEMBLY INTEGRITY                      | AFTER THE CASE IS WELDED, HELIUM LEAK TESTS ARE PERFORMED TO VERIFY HERMETIC SEAL. ALL VENDOR INSPECTION AND TEST CRITERIA IS UNDER ROCKETDYNE APPROVAL AND CONTROL. TRANSDUCERS ARE SUBJECTED TO A WORKMANSHIP SCREENING ACCEPTANCE TEST INCLUDING VIBRATION AND THERMAL CYCLE. |                                      |
|                | HOT FIRE ACCEPTANCE TESTING (GREEN RUN) | SENSOR OPERATION IS VERIFIED THROUGH HOT FIRE ACCEPTANCE TESTING   | RL00461                              |
|                | DATA REVIEW                             | ALL CONTROLLER DATA FROM THE PREVIOUS FLIGHT OR HOT FIRE IS REVIEWED. ANY ANOMALOUS CONDITION NOTED REQUIRES FURTHER TESTING OR HARDWARE REPLACEMENT PRIOR TO THE NEXT FLIGHT.   | MSFC PLN 1228                        |
|                | PRE-FLIGHT CHECKOUT                     | SENSORS ARE VISUALLY INSPECTED   | OMRSD V41BU0.030                     |
|                |   | SENSORS ARE DYE PENETRANT INSPECTED FOR CRACKS AFTER EVERY FLIGHT  | OMRSD V41BU0.225                     |
|                |   | SENSOR OPERATION IS VERIFIED EVERY MISSION FLOW BY SUCCESSFUL COMPLETION OF THE CONTROLLER SENSOR ELECTRICAL CHECKOUT (LAST TEST)  | OMRSD V41AQ0.010<br>OMRSD S00FA0.213 |

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)  
 Reference: NASA letter SA21/88/308 and Rocketdyne letter 86RC09761.  
 Operational Use: Not Applicable.

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